THE QUARTERLY MAGAZINE OF THE NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY
VOL. 12/NO. 3 WINTER 1974

Terra

An X-Ray Life After Death A First Step in Paleopathology of Mummies

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We Get Letters

November 1, 1973

Dear Ms. Seligman and Staff;

Received the Fall 1973 issue of *Terra*. Oh, such a nice surprise to find the lovely calendar inside. The Polar Bear Habitat Group is my favorite of all the Museum and it was a thrill to see it for January.

Thank you so much. Just wanted to let you know your magazine is appreciated.

Yours truly,
Mrs. N. Valentine

November 1, 1973

Dorothy Seligman, Editor, *Terra*
Natural History Museum
Los Angeles, California

Dear Miss Seligman,

Thank you for the beautiful Calendar in this month's *Terra*. What a nice gift, and what a great idea.

We really need it, too.

Yours very truly,
David and Corrine Gelbard

November 9, 1973

Editor—Dorothy H. Seligman
Terra Quarterly

Dear Mrs. Seligman and Staff,

Your fall issue was a real "brain-storm." That *beautiful* calendar! Who thought that idea up?? It is gorgeous, with a most remarkable selection of pictures. Thank you from *ALL* of us.

...

Are these issues available for purchase? I am enclosing an addressed post-card for a "Yes" or "No" answer. I can think of no nicer Christmas gift to friends interested in natural history than one of those calendars; and it might just influence a few non-members to join our group.

I know I shall enjoy 1974 more because of the stunning pictures and your clever idea!

Gratefully,
Phyllis W. Edwards

Terra®

The Quarterly magazine of
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of Los Angeles County
VOL.12/NO.3WINTER1974

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Cover color photo of Peruvian baby by James Muche.

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An X-Ray Life After Death

A First Step in Paleopathology of Mummies

by **Nancy Peterson Walter**

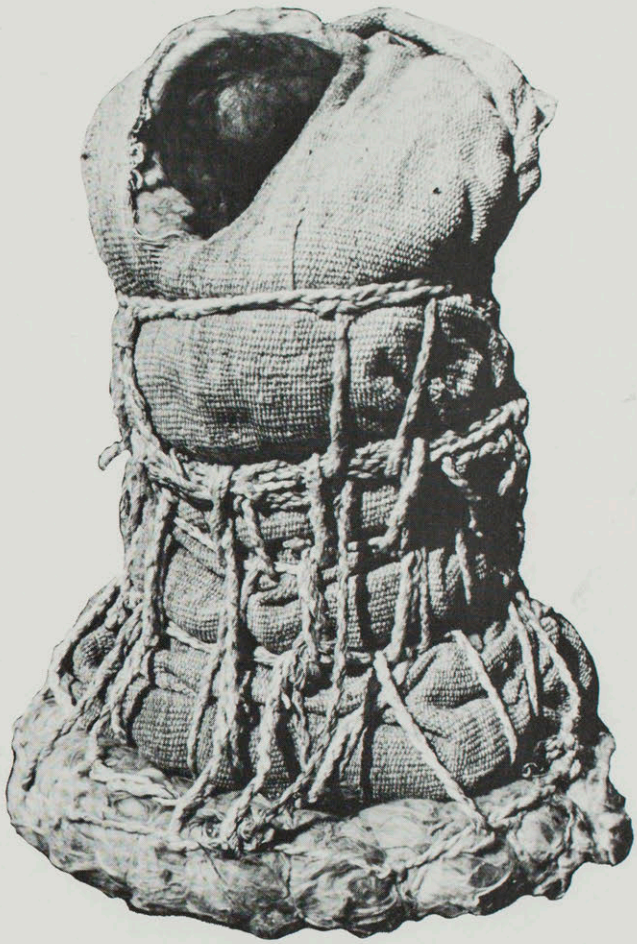


Photo by James Muche

PU lies in his glass case on the first floor looking at the ceiling with open eyes and mouth telling us little about himself. We know his name is PU, that he lived during the Ptolemy period of Egyptian history between 332 B.C. and 27 B.C.; but we do not know why or how he died. Are there any ornaments or jewelry in all those layers of linen wrap? After staring at PU for considerable time, we decided that an x-ray could answer many questions. If PU harbored some interesting tales all these years, the thousands of people who stopped and looked were really missing some portion of valuable history. Then again PU might not have much of a story to tell.

PU lived during a time of transition in Egypt. Alexander's Empire had collapsed, and the Ptolemies had inherited Egypt. The embalmers of this era were considered somewhat sloppy since Egyptian funerary practice had reached its peak several hundred years earlier. Had PU been a victim of this kind of embalming? The whole mortuary practice went downhill to such a degree that after Cleopatra, the last of the Ptolemies, the Romans influenced the Egyptians to return to practices that existed approximately five hundred years earlier. PU was embalmed during this decline in Egyptian mortuary practices. It was a time when bones of animals were substituted for human bones, when clay was used to round out the figures before wrapping, and when some bodies were filled with stones and broken bits of pottery.

Had PU undergone any of these misrepresentations? An x-ray would end all doubt, as well as possibly give a clue as to why he died when he was in his late fifties.

The museum has also acquired a Peruvian child mummy bundle which was intriguing for many of the same reasons as PU. The soft spot on the forehead was clearly visible on this infant which was so delicately wrapped. Red ocher had been painted across the forehead; the cowl of the wrap came up to cover the head in a protective manner. Was any artifact inside all this wrap?

X-rays of both mummies would provide insights as well as enable this museum to do what several other museums in Europe and Egypt have done—display an x-ray next to each mummy.

Atomics International, a division of Rockwell International, was willing to cooperate in doing a thorough study of the two mummies. So after many years between marble columns in the museum

PU was removed from his case to travel with the Peruvian child to Atomics International in Canoga Park, California. While the two mummies were on their way, many technical problems had to be worked out as to how the x-raying was to be accomplished. Phone calls were made to Kodak in Rochester, N.Y., and to the British Museum of Natural History. It was learned that the British Museum uses Kodak "Blue Brand" x-ray film while Atomics International had type "M" Kodak x-ray film. The specific differences between the two films had to be known so that all would be ready when the two mummies arrived.

All was ready when the mummies reached their destination. The technicians helped to place them on the floor and then positioned the x-ray equipment above PU, who was to be x-rayed first. As the mummies seemed so fragile, everyone was hesitant about handling them. After a while, this apprehension diminished, and the work progressed at a fast rate.

The first x-rays of PU's head took everyone by surprise. Even though the face has been exposed for years, probably long before Dr. Peter Janss acquired him for the museum in 1923, there was still a lot of linen wrap around the head, and the x-ray showed several complications that were definitely mysteries. PU looked like he was receiving acupuncture treatments! There were long needles coming from all directions all over the head. The first few seconds of astonishment faded when the realization came that throughout the years, the linen wrap had become loose, and these were the pins which had been stuck into PU at random to hold the linen wrap in place. These pins were all over PU from his head to his toes. This took care of one mystery but left others. There were little odd shapes on the sides of the head which were not part of the skull, yet seemed to be part of the skull. Side views could clear up this problem we hoped, so the x-raying continued.

PU's eyes, nose, and mouth, at the time he was embalmed, were stuffed with linen which had been saturated with resin which prevented getting x-rays of the teeth above and beyond the front and side head views.

The first x-rays of PU's chest confirmed that the embalmers had not done the best job that could have been done. The breast bone is totally missing and every rib is broken at least once. In the wrapping, the shoulders were hunched so that the shoulder blades and collar bones look distorted. In studying the x-ray it became more evident that this amount of damage to the total rib cage would have had some effect on the back bone, but as it turned out, PU's whole vertebrae column was in excellent condition. Another mystery solved but still nothing to indicate what might have caused his death.

In placing PU on the floor, several of us had noticed that there was something of a rigid nature running down between his legs to his feet. The possibility of a staff or similar artifact was then speculated so that the next x-rays were anxiously awaited. When they came out of the processing machine and were placed on the light box, nothing appeared except bone and the ever present pins. Something was there because we could feel it. Only after careful examination of the x-rays could we see the thin reeds or sticks in the pelvic cavity and were then able to trace them down between the legs as well as back up into the chest cavity.

In checking the wrap where it had been torn away around the chest, the tips of two of the sticks could be seen, and when moved, the linen wrap around PU's legs would move. We could make PU's body move—at least appear to! It was not an uncommon practice among some of the early grave robbers to stuff the mummies with sticks so that they would transport easier.

The demand for mummies is great today. There is a regular, though admittedly not very heavy, demand at a New York pharmacy catering to witches for genuine powdered Egyptian mummy. The going price several years ago was around forty dollars an ounce. PU was beginning to show signs of having lived an exciting life after death.

As the x-raying continued, the next noticeable thing about PU was that he had enormous knees. There were several interesting aspects relevant to his feet, too, but how much of this was pathological and how much was due to the method of wrap would have to be determined by a radiologist.

All of PU's long bones showed marks that are referred to as Harris lines. These transverse lines across the long bones are often called lines of arrested growth as they illustrate that during childhood when the individual has been afflicted with prolonged periods of hunger or illness, the long bones quit growing. At differing times while PU was growing, he experienced prolonged malnutrition or illness.

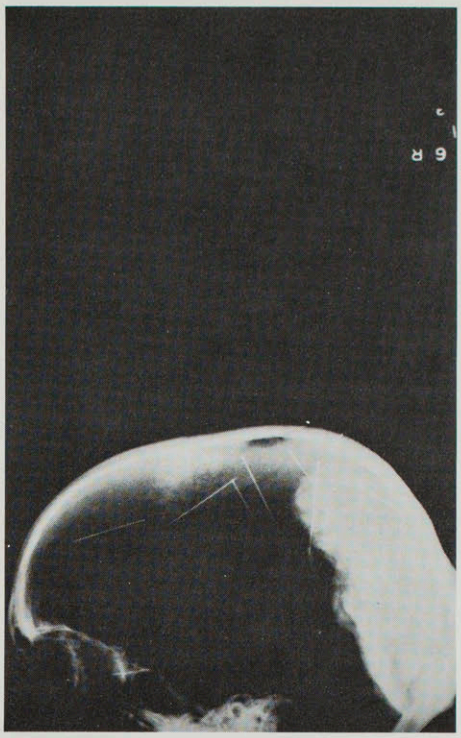
The side views of PU did nothing to clear up the mystery of what was in and around the skull. In fact, the x-rays tended to illustrate more problems. There was a large deposit in the back of the skull which could not be easily interpreted. If PU had had a brain tumor, it wouldn't have had a chance to get large enough to have left a calcified deposit that big. And then there was the problem of the little triangular shapes which showed up in different places throughout the skull. Both of these mysteries were solved within several hours.

As PU was moved for the Peruvian mummy to be placed into position beneath the x-ray equipment, there was a noticeable glint in one of his eye sockets. Closer examination showed that there were bits of glass in the linen stuffed into that eye socket. Glass! This explained why the bits and pieces were angular, tending to look triangular. If PU had been in a glass case which had been broken, part of the glass would have fallen into the linen wrap around the skull. One mystery solved and one to go.

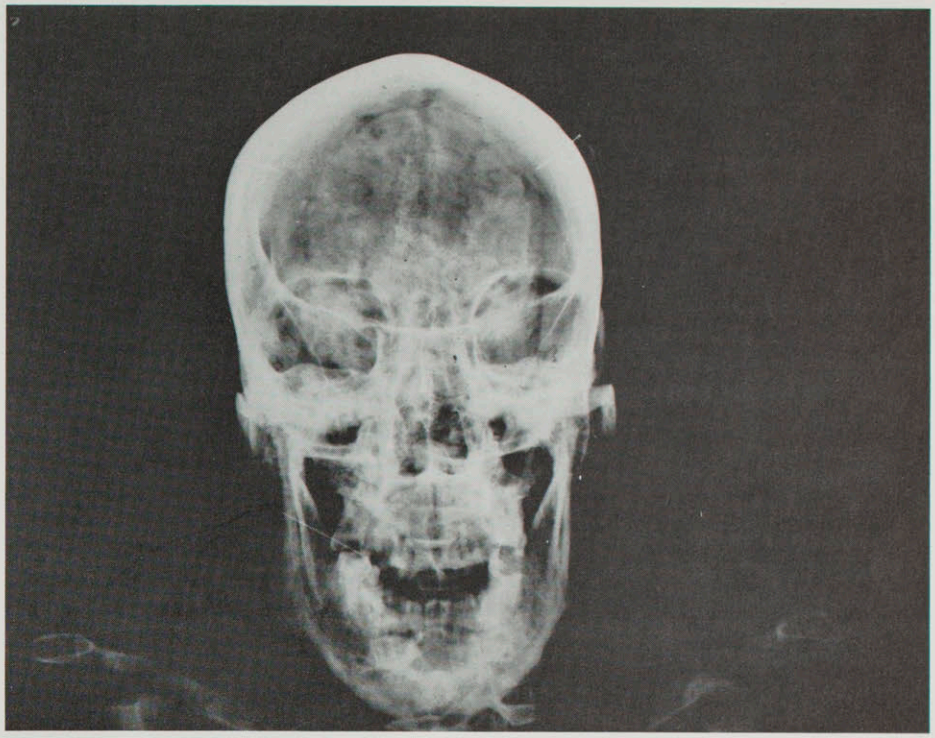
In reviewing the literature concerning x-rays of mummies of the Ptolemaic period, there was a picture of an x-ray showing a large deposit at the base of the skull exactly like the one in PU's x-rays. It seems the common practice during this time was after stuffing the nose, eye sockets, and mouth with linen, resin was then poured into the skull. Problem solved! The large deposit was nothing but linen soaked with resin.

The x-rays of PU didn't give information as to why he died but do tell a story about the embalming practices of that era as well as some of the experiences PU has had since being embalmed.

The Peruvian child was quite small and only required four x-rays to get all of the body, both side and front views. The quality of the industrial x-rays enabled all of the delicate infant bones to be visible. As the first x-rays came out of the processing machine, the first thing everyone noticed was the necklace. The child was wearing some type of bead necklace which had broken, scattering the beads down the backbone on into the pelvic area. In examining the x-ray, it was noted that the beads did not have the density of either metal or wood. The animal and vegetable fiber in the mummy bundle was easily detected and allowed observation of the individual fibers. This had not been true with the fabric from Egypt. The Egyptian linen only shows up on the x-rays where there are edges—mainly those around the face where the



Side view of Pu showing resin deposit & glass



Pu's head
note straight pins

Side view of Peruvian child illustrating the broken necklace and collapsed rib cage

Pu being x-rayed

wrap has been ripped.

The child was probably not quite a year old when it died as just six teeth had erupted. There were three upper and three lower teeth with the rest showing up in the x-rays as tooth buds. The soft spot shows up with all of the fragileness of real life. The side view shows that the infant is in a kneeling position. Most Peruvian mummies are flexed so that the knees are almost to the chin, as was their custom. In this case, the age of the child may have been a factor in the use of a partial flex.

All mummies found in the New World (North, Middle, and South America) are the result of natural dehydration of the body fluids. No embalming took place in Pre-Columbian times. In those areas where mummies were found, the dead were wrapped and put in a place where little moisture reached the bodies allowing for this dehydration. In observing the side views of the Peruvian mummy, it could be seen that during this process the ribs collapsed and fell into the pelvic area. The skull was supported by the wrap, but the back bone fell intact into the rib cage area separating itself from the head. The x-ray revealed nothing pathological with regard to the cause of death but did give an excellent illustration of how delicate our bones are during the transition period of cartilage becoming bone.

In order to have learned the same amount of information but without x-ray, it would have been necessary to unwrap both mummies. This is frequently a time consuming process, and once unwrapped, they can never be rewrapped. The very process of unwrapping frequently destroys the mummy. The embalming resins soak into the linens which adhere to the flesh and bone of the Egyptian mummies. The body fluids drain into the wrap of the Peruvian mummies so that frequently the wrap will adhere in the same manner as the Egyptian.

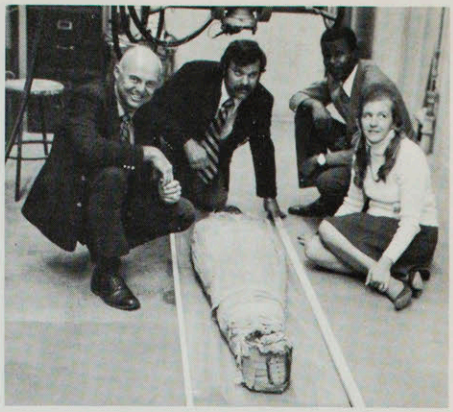
While x-raying the mummies, they can stay intact for display and quite a bit of information can be obtained without affecting the mummy. If something shows up on an x-ray which would warrant further scientific investigation, then the matter of total or partial unwrapping can take place.

In the case of the Peruvian mummy, flesh and hair samples have been taken for microscopic examination as they were easily obtained without affecting the display purposes. Samples from PU were not taken because the use of resin during the embalming process contaminated the hair and flesh. Studies have been done to determine the type of resins used during the various eras in Egypt and show that use was made of many gums and oils from a host of North African plants.

An x-ray can tell the scientist quite a bit about a mummy. The next time you are strolling past PU at the Natural History Museum of Los Angeles County take a look and see for yourself.

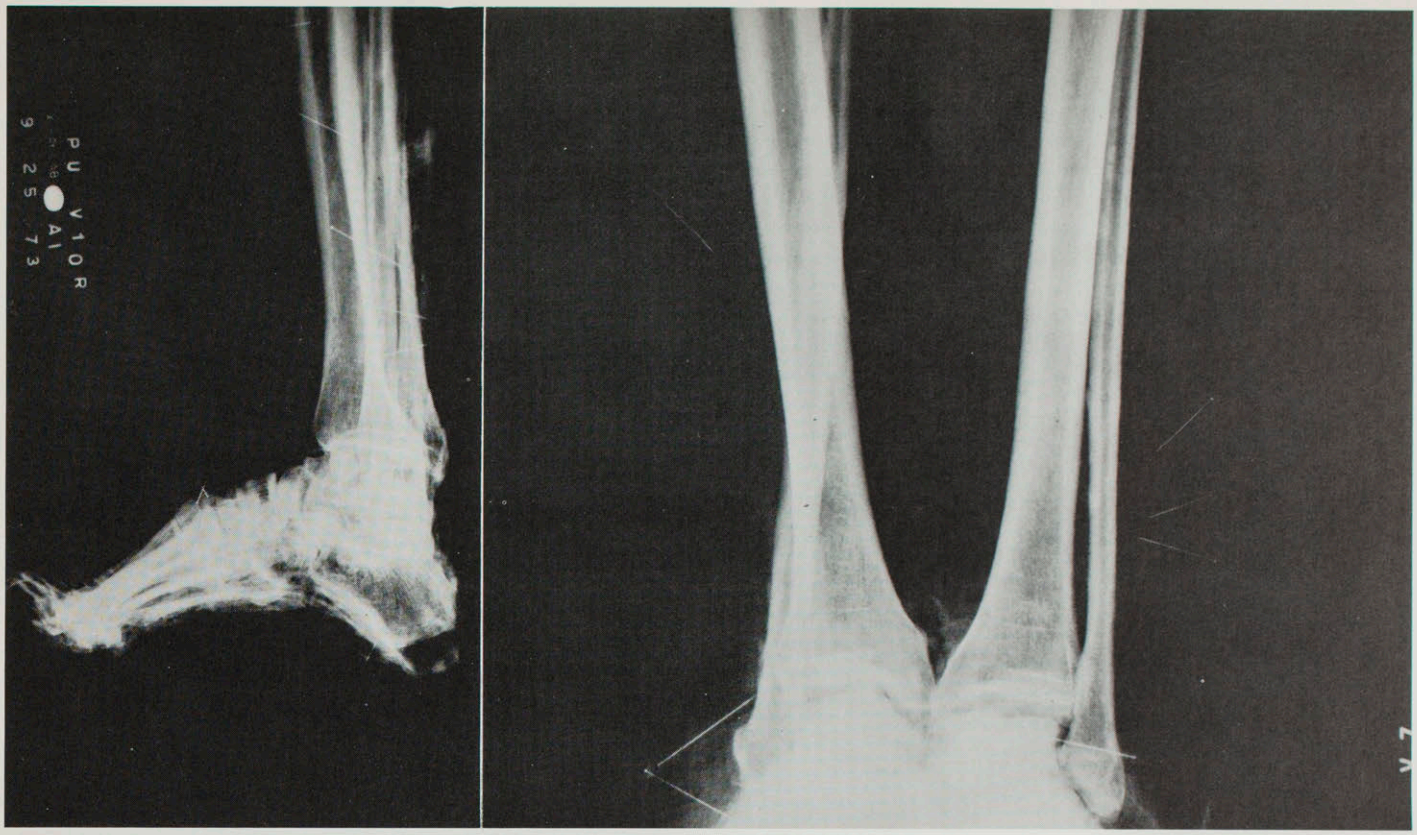
Nancy Peterson Walter is a research associate in Archaeology and instructor in anthropology at California State University, Northridge, and Los Angeles City College. This is her first appearance in Terra.

I wish to thank the staff at Atomics International and Bill Lystrup of the Los Angeles County Coroner's Office who photocopied the x-rays.



Dr. Charles Rozaire, Jay Bisno, Wilbur Knight—engineering supervisor in charge of x-ray lab at Atomics International, Nancy Walter, Pu & x-ray machine

Pu's well broken up rib cage



Pu's well bound feet

Harris lines are shown on Pu's lower legs. The line down the middle is one of the sticks which extend down from the rib cage to hold the body rigid.

In Pu's lower rib cage the sticks which extend to the feet can be seen.

Anthropologist as a Fortune-teller

by **Marlene Dobkin de Rios**

The author as fortune-teller

Anthropologists have done many things in their day to get a story. The extremes of getting anthropological data can include "going native," taking drugs with the local shaman, setting up housekeeping with a young man or woman, or just never going back home. Some, like one European nobleman, spent years in the South American tropical rain forest, gathering materials. Yet perhaps none is quite as much fun but so frightening as becoming a fortune-teller in a foreign land, in a foreign language, all in the name of science.

My experience with fortune-telling started when I was a young graduate student studying anthropology in New York. Attending classes at night and working days for an airline company, I traveled to Paris one Christmas and one night visited Pigalle to have my fortune told by a golden-earringed gypsy woman. Everything she said miraculously came true, from the obvious "you will soon take an ocean journey" to a host of other predictions about romantic happenings.

Five years later I spent a summer vacation from college teaching in the Peruvian Amazon to have a look at the country where I hoped to be doing field work the following year. Working with social psychiatrists and psychologists on a study of folk healing with a mescaline cactus in the north coastal area of Peru, I spent about two and a half months in a small village where mescaline healing was the main attraction. Patients drawn from all over Peru came to visit the more than 100 men and women who were famed for their drug healing skills.

One night I heard a folk healer tell his wife, as his drug session was about to begin, that she should bring the fortune-telling cards, called *naipes,* to the ceremonial area some distance from their farmhouse. Eidetic images of my gypsy fortune-teller clicked in my brain. When I asked Don Antonio if he used the fortune-telling cards, he denied it and changed the subject.

Still persistent, I found decks of *naipes* for sale in a nearby city close to the healing village. Cheap pamphlets could also be purchased in Spanish, instructing the serious student in techniques of card readings. Some dated back in time to Napoleon's day. I bought as many as I could find and sat in city restaurants carefully transcribing the information for each card on two by two index cards.

That summer of 1967, by the time I left Peru it would take me about an hour and a half to weave together some kind of tale.

I left Peru headed for a teaching job in Southern California. When settled, I set to work to figure out how these cards really worked. Aided by a few engineering friends, who were steeped in probability statistics, we worked out a mathematical formula linking the presence of certain misfortune cards (including sickness, death, anxieties, woes, ill usage in love affairs, and business failure) to diagnostic use by folk healers. We put together a statistical table on the cards, showing that folk healers who used them to diagnose illness before prescribing their psychedelic brew were able to tap psychosomatic stress and tensions. These cards pointed up etiological factors in many emotional and psychological disorders faced by patients who looked to help from such healers. As work on the *naipes* progressed, I became more proficient with the cards and even told the fortune of one widely renowned psychiatrist whom I met at a professional meeting in Bogota that year. However, my real success crystallized when I returned to Peru in 1968 to live for a year in a small Amazonian city, Iquitos, located some 2,300 miles inland from the Atlantic Ocean.

There, working again on folk healing with a psychedelic substance, this time a visionary vine called ayahuasca (containing an indole hallucinogen called harmine), I moved into the slum of Belen at the foot of the Amazon River. My home was a seven meter square shack set upon a balsa raft. It was moored to a fast-disappearing dock, as the river rose and fell each day. People in the thousands lived in the slum and worked mainly at wholesaling jungle produce such as fruit, vegetables, game pelts, tropical fish and birds and other forest products. They were bought as cheaply as possible from small canoes and motor-driven wooden boats that arrived in the slum daily, to be resold in the city market a few miles from the docks. My work in the slum consisted of obtaining ethnographic data on belief systems and the way of life of these people, many of whom when ill used a series of psychedelic plants like ayahuasca to treat illnesses they believed were caused by witchcraft.

The first months in the slum were difficult. I was overwhelmed by the level of poverty all around me and the destitute conditions of the men, women and children. Attending several ayahuasca sessions with friends I had made in the slum to observe healing sessions and ritual, I learned a good deal about this powerful plant psychedelic and how the visions it caused were used by healers to identify the evil person or malevolent spirit believed responsible for whatever harm befell an individual. I even took anahuasca myself several months after my entry into Belen. However I didn't realize how much I was being drawn into life in the community until one day, almost as a joke, I brought my well-thumbed fortune-telling cards down to the slum with me. The family with whom I had a sort of fictitious kinship relation was delighted by my skills, which were still far from perfect. Nonetheless, most of the following days were spent practicing telling fortunes. Little by little, people both familiar to me as well as strangers wandered by to have their fortunes told. Although I felt I was getting better as the weeks passed, I had the feeling that no one was taking me very seriously, especially since I refused to take any money.

A certain amount of skill was required to take the separate items associated with each card and turn them into a story so that three or four cards read together presented a short narrative. Furthermore, many of the cards had several diverse possible readings. In most cases, I had to choose the pertinent item that I thought applied to the man or woman before me. I found myself becoming more flamboyant, dramatizing my readings by hesitating at particular points and exclaiming at still others. Cautioning clients against possible evil in store for them, and joyous when good news seemed forthcoming, I was really drained emotionally after telling four or five fortunes in a row, as frequently was the case.

However my career wasn't really launched until about the sixth month of fieldwork. I left Belen for a few weeks to give a paper about my drug work the summer before in the north coast of Peru. While in Seattle attending an anthropology meeting, I told some of my colleagues about my new data gathering technique and how I wasn't taken too seriously since not charging for my services meant locally that I was only an apprentice. Against my better judgment, but on their advice, I resolved to begin collecting money for my readings. Everything in Belen, in fact, had a pricetag, and there seemed no reason not to comply with tradition.

Back in Belen I was bothered a good deal at the idea of taking money from people who were really needy. I tried to rationalize this in terms of the amounts spent every week on medicine and the gifts of food I was always making. I decided that for every penny or two received for a reading (much cheaper than my nearest competitors, who charged fifteen or twenty cents for the same service), I would give the earned fee to the nearest youngster to buy an ice cream. So I opened up a consultation office in my little house to receive increasing numbers of clients. Fame spreads quickly in the slum. Aside from the fact that my rates were cheap, the techniques adopted from others in the city like me were familiar to most of my clients. An especially successful one permitted people to ask three questions of the cards about anything they wished. The answer was either yes or no. If a particular good luck card turned up (I turned up every second card), the answer to the question was yes: otherwise the reply was negative.

No longer did I have to stop people in the street to ask if they wanted me to tell their fortunes. Rather, hosts of people came to visit me, especially on Wednesdays, Saturdays, and Sundays, days considered propitious for fortune-telling.

Friends operated as agents without any prompting on my part. They would drum up business and often urged me to raise my prices since the reading was, in their opinion, too cheap. Men would jump out of their canoes at dawn to ask their fortunes before setting off on a trip. One woman, a neighbor, came to have her fortune told. When I returned to Belen after a few days' absence, she confronted me with the following: "Marlenita, you predicted the death of my little daughter!" Appalled, I realized that although I consistently repressed the death card so as not to burden my clients with any more misfortune than seemed to be their normal lot, Enith had taken one of my predictions and distorted it to fit the actual happening. What I had told her was that there would be money in the household. The day after the reading, as I later learned, her ex-spouse came by and gave her some money for their child's food. The little girl, sickly all week, died that evening and the alimony was used for the wake. Before the day was out, people all over the slum had heard that the Gringa had predicted the death of Enith's baby.

As time passed, I saw how magic worked first hand. Although many of my

predictions would come true, many more that I remembered and recorded at the end of a busy day and later inquired about, did not. Yet, people tended to remember the things I had said which did occur and conveniently forgot what was not in the offing. Repeat business frequently came my way, as I made it clear that the cards were temporal in nature and one's fortune could always change. I found myself, at the end of a day's hard labor, able to chat with neighbors about our shared fatigue, since I too was busy with insistent clients. My place in Belen became fairly well established, it seemed, now that I had a highly valued job in the community.

My fieldwork with ayahuasca benefited greatly from my fortunetelling activities. I found that clients would often talk to me while the reading was taking place, telling me who the particular figure cards in their reading might be, those good or evil persons who could contribute to their luck. Tales of adultery, connivances, evil doings, hatred, opprobrium and a host of emotions that might never be elicited from normal interviewing techniques flowed in a steady stream of conversations from my clients. I found that the cards and the standard misfortunes could be used to cross-check the data I was gathering elsewhere on witchcraft beliefs, philosophy of disease causation, and patterns of stress. Certainly, tensions and conflicts contributing to psychosomatic illness were readily apparent.

The most frightening aspect of my unconventional technique was the personal feeling, never quite shaken, that despite my training as an anthropologist and awareness of the forgetting phenomenon, the cards never seemed to lie. True, they might be inaccurate at times, but the feedback from clients was too consistent. During the time I was a fortuneteller, I never considered my actions as some kind of trick merely to get people to talk. Too many of the things said, as I mentioned, seemed to come true. I often felt that despite all those years of schooling to be an objective social scientist, the cards and the subliminal cues I would receive from my clients all contributed to achieving certain types of readings. Sometimes the cards frightened me, especially when death or bad fortune occurred. Peoples' questions at the end of their reading often brought forth additional material which indicated just how close I had been to hitting the mark.

Objectively speaking, however, I knew that the categories of good and bad fortunes that were involved were so general that I was just playing the odds that certain events would occur. Nonetheless, I found much to my surprise, that when I told the fortunes of young men and women, data on love affairs and romantic interests would invariably be predicted. When older men and women were my clients, on the other hand, my remarks might include "your cattle will prosper" or some such.

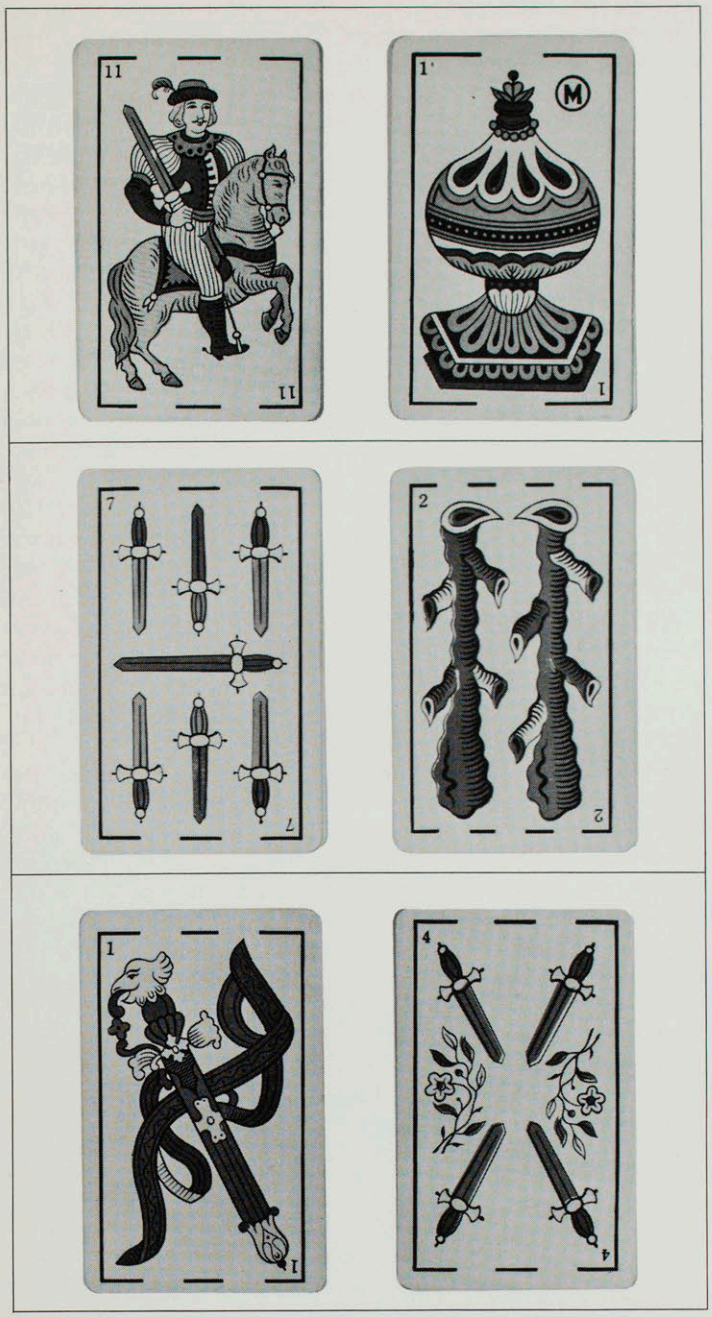
One day, a client who was a grandmother, toothless and not totally unattractive, came to have her fortune read. Others had told me that she was a medium and spiritual sessions often were held in her little house. Full of family misfortune, her youngest daughter had run away from home with a soldier, and her oldest daughter was sick in bed with a post-partum infection. The cards predicted that a handsome man would come into her life. During the questioning period, she asked if his intentions would be honorable. The cards said yes. When the reading was over, she turned to me and said, "Oh, Marlene, you know that I'm too old for that sort of thing." I had to agree, as her dignity was such that the term "armorous fury," taken from the medieval prose of the cards, didn't seem to apply to her very well. I really thought the cards had made a mistake but said nothing more. Three weeks or so passed and Maria returned. I wondered why she was back so quickly. She listened patiently this second time to the cards, but seemed anxious to ask the three questions. When this moment arrived, I was the one who was floored, as she asked if her new boyfriend would move in with her.

As these types of incidents repeated themselves, I began to boast, not too much, but just as I observed others like me did, about my successes. After all, word of mouth in the slum with a functional illiteracy rate of about seventy-six percent, was as effective as radio announcements on small, transistor portables which could be found everywhere. Successful predictions accumulated. By the end of the eighth month or so of fieldwork, the walk from the city market, normally taking about ten or twelve minutes, began to take longer and longer as people would tug at my sleeve and ask me to come into their house to tell their fortune. One woman ran after me and by way of introduction said she had heard that I was the Gringa who knew things.

People often wanted their fortunes told in private. One woman, originally from Brazil, had a very jealous husband. One day, settled in her run-down shack, I began to tell her fortune and noticed that my client was getting visibly nervous. Her house was full of neighbors, all women, since a heavy downpour had begun and no one wanted to venture out in the rain. Her agitation increased, especially as four Kings appeared, each one of whom indicates a particular man. She abruptly asked me to stop which I did, thinking I had somehow offended her. Finally the rain let up a bit and the other women left. My friend, Olinda, sighed with relief. She told me of the problems she was having with these neighbors. Every time her husband returned from a fishing trip that lasted several weeks, these women would come to him in secret and tell him of the other boy friends Olinda had when he was away. Olinda was certain that the evidence of the four Kings would be used by these vicious neighbors to further incriminate her.

Throughout my year's fieldwork, the cards were my constant companion. Since that time, I have written a study on the cards, comparing the themes I elicited in the questioning period to traditional psychological tests, such as the Thematic Apperception Test (TATs), which like other social scientists, I gave at the end of my fieldwork. But I am quite sure that however reliable and objective these more traditional devices are, they could never capture the feelings of the future as the *naipes* did from my Peruvian divining days.

Marlene Dobkin de Rios, Ph.D., is an anthropologist whose research has been in the use of psychedelic plants in traditional societies of the world. Aside from her research reported on in this article as a fortune-teller, which served the purposes of data gathering, Dr. de Rios has published a book, Visionary Vine *(Chandler, 1972) and numerous articles on the role of psychedelic plants used in the primitive world for healing, witchcraft and religious purposes. Most recently, she prepared a monograph on the non-Western use of hallucinatory agents for the National Commission on Marihuana and Drug Abuse.*



Fortune-telling cards called *naipes.*

Bananas being unloaded in Belen

Scene of Belen

Scene of Belen

Our Sea Serpent

by **William Emboden**

"Sea serpent. A large marine animal resembling a serpent, often reported to have been seen, but never proved to exist."

Webster's Dictionary

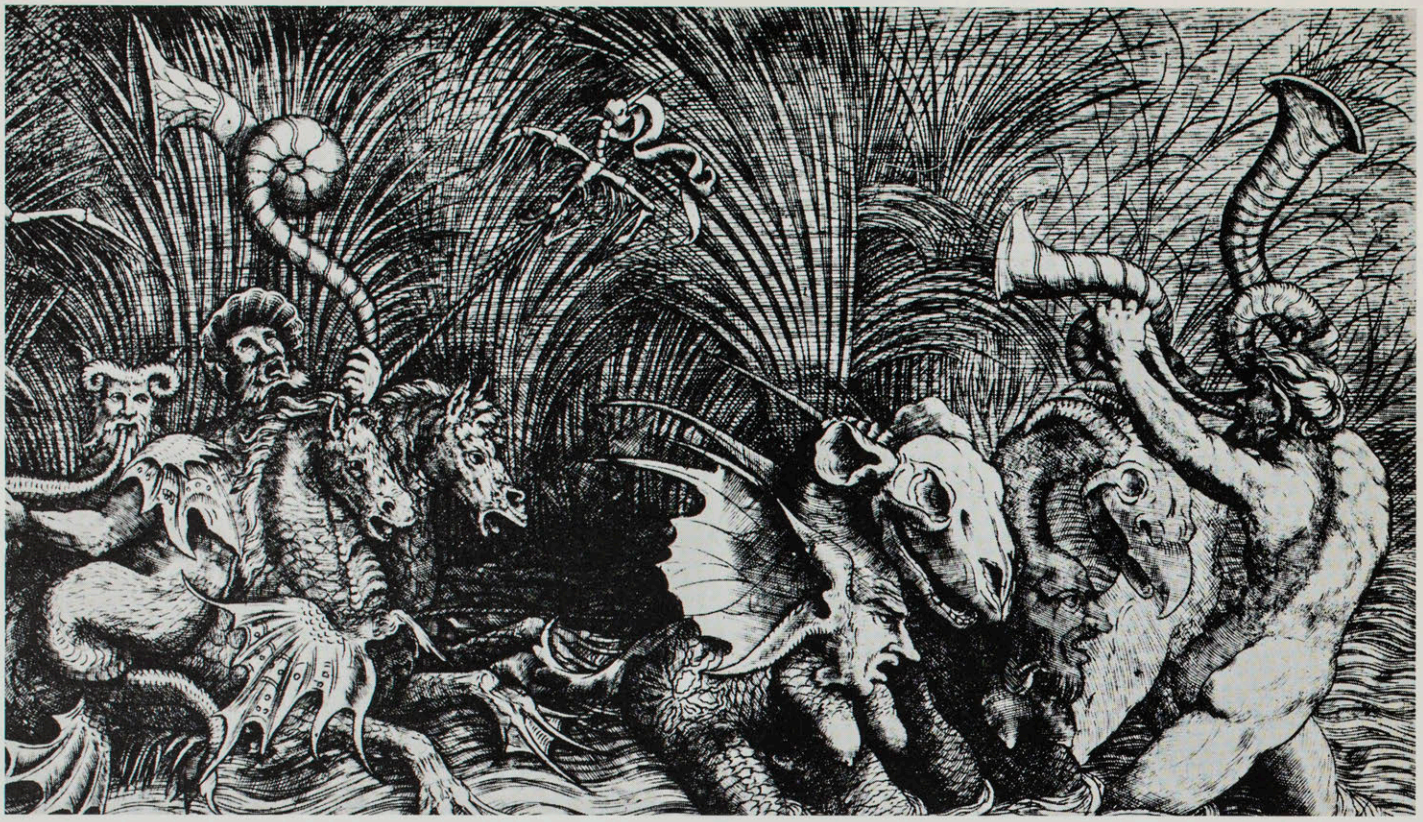
I hadn't seen it yet, only the impressive coffin of over 20 feet long. Rumors had floated about the Museum that it was still alive when Mr. John Prescott found it on Leo Carillo Beach here in Southern California. Six brilliant red "plumes" on its head! I had visions of a design by Erté. Curiosity led me to the roof of the Museum (where one may find anything from a dessicated fish to clandestine romance). Casting had already begun, but it wasn't too late, I was told, to see "the thing" unveiled. As the head emerged, I was a bit disappointed in the pallid creature that scarcely measured up to my expectations. Its mouth, not so large as to be able to devour much more than small fish and plankton, was turned up in a toothless and dour expression that one expects to find on aged executives. Nor was the red-spotted silver-blue body evident, only a flounder grey that went on and on; yes, it did go on for nearly nineteen feet until one came to the point where it had confronted a shark. Serpentine? Well more like a boa constrictor on a busy highway. Flattened in a vertical plane, one could imagine this "sea serpent" writhing through the water with its flame-like dorsal fin cresting the waves. After all, they do attain thirty-five feet or more; ours was only a youngster as monsters go. Beached with the hounds nipping at her heels (and no ice floes). It is always sad to see another "rarey" disappear, and this deep water fish has been infrequently spotted in the last decade. Ours is unique and forms a type specimen for the museum collection. Looking at her I wondered if sea serpents were on the list of endangered species. I contemplated her, arched over a frame designed to approximate her writhing in life. Mme. Tussaud would have loved the things that they were doing to preserve her as well as her likeness. Resin, plaster, algin, sprays, tints—nothing would be spared casting and recasting every inch of fin and every filament of gill. I ruminated on Browning's Last Duchess and smirked a bit, thinking that this was a hell of a lot more trouble than any portrait. Not only the artist (Alex Kricheff) from Exhibitions would have to be satisfied, but the ichthyologists as well (no mean task). No director could afford to be embarrassed by an aberrant sea serpent, and God knows, there is a critic passing through every museum who has spent his life on just such a creature and will spot a badly positioned fin or posturing that is awry. Well, it did take a long time to perfect her, but on that day when I wandered alone in the Marine Hall and came upon her it was breathtaking. Browning again, ". . . looking as though she were alive." Her color and form were perfect, the eyes gleamed, the red fin seemed like a strident laser beam on her back. This creature nullified all of the other displays for the moment, for here she was held aloft by a few thin rods, and in a pose that must have frightened more than one fisherman. Surely she had some herring forays around boats. "Denizen" seemed the appropriate word for her; "Fish," no. Sea serpent was fine too. She was far beyond any flounder or tuna fish in grandeur. Perhaps something like the serpent that Pliny tells us attacked the army of Regulus or the RoOrum of Olas Magnus (although her mouth could hardly snap a ship's mast, being little larger than a fist).

Intrigued, I sought other sea serpents, encountering on the way the shy, but much-discussed, Loch-Ness monster; the famous five-toed, silver maned, thirty foot reptile found at Stronsy in the Orkney Isles in 1808, and innumerable tales of the ancients in which large ships were attacked by serpents. More to my interest were the stories issuing forth from our own Atlantic seaboard throughout the nineteenth century.

The *Portland Gazette* christened their monster "His Snakeship," and were annoyed at his unregal pursuit of herring and his detached attitude toward people. His Snakeship granted audiences on June 31 and July 14 of 1818 (which was a big year for sea serpents) paying little attention to his admirers; a few thrashings in the surf for small fish, and his congee was made without incident. His Snakeship ruffled the press by flaunting the proffered publicity.

It was once said that no ship sailed out of Boston's harbor without encountering "The Monster," and yearly he was seen in every major cape from Maine to New York. Such a flirtation between Monster and Man seemed calculated (by the Monster). According to Boston's newspaper *Gleason's Pictorial Gazette* one of the great encounters was on August 6 in 1852 when the frigate H.M.S. *Daedalus* on her journey home to London passed the Cape of Good Hope and St. Helena. Captain M'Quhae and his officers were on deck while the crew was dining. At five P.M. a sea serpent was spotted and followed in the glasses of the officers. The grand creature headed toward the ship with its head four feet

A twenty foot monster, our "oarfish"
in the new Marine Hall of the
Natural History Museum



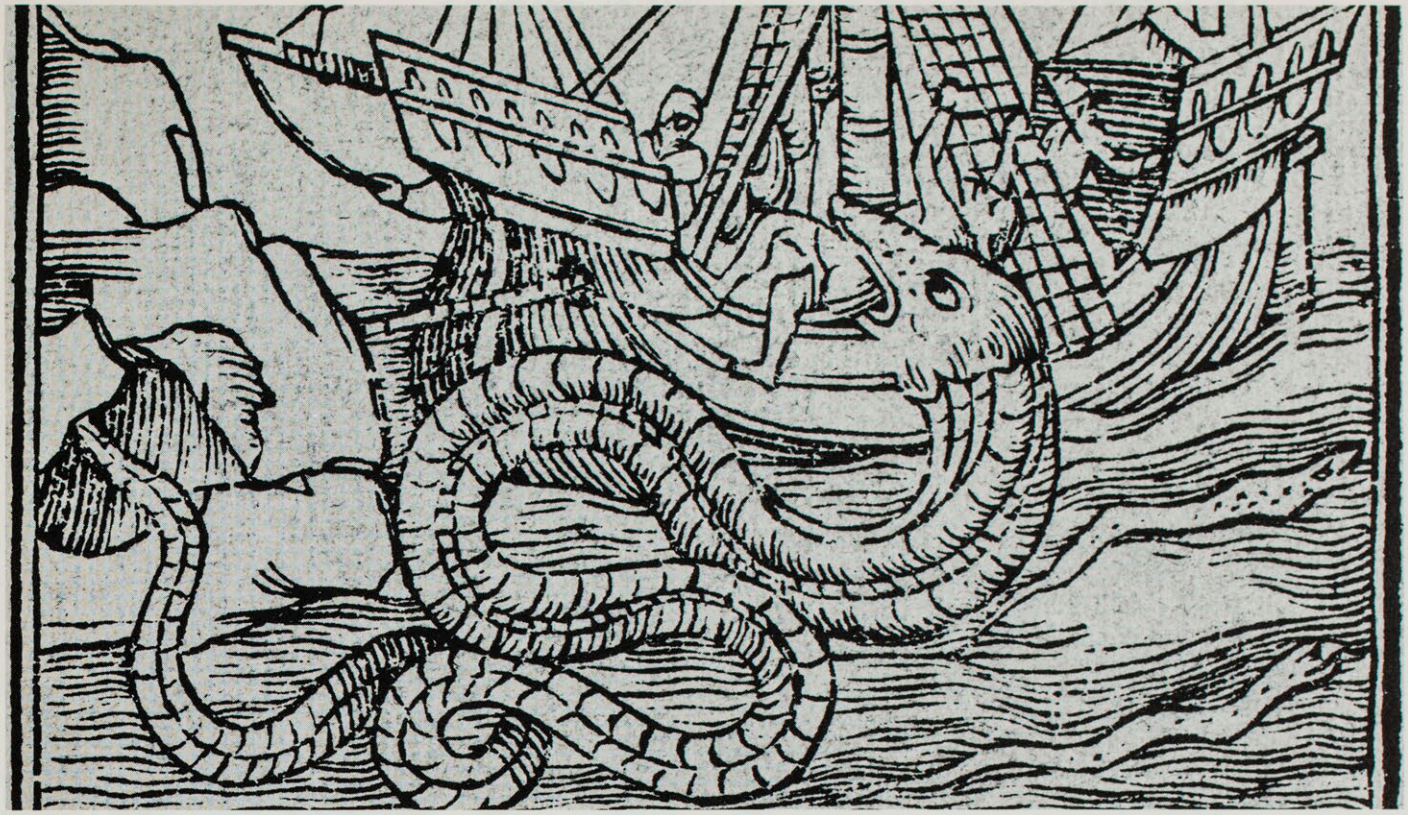
"Sea Monsters" circa 1530 by the monogrammist H.E. (engraving)

out of the water and sixty feet of its dorsal side in plain view (an estimated thirty or forty more feet being under water). Its breadth was estimated to be sixteen inches in diameter. This is rather astounding when followed by the assertion that the jaws when open would admit a man standing upright between them. This giant was traveling at a speed of 14 miles per hour. When queried by the London *Times* M'Quhae wrote a letter substantiating his bold assertions, noting further than the monster's determined path was in a southwest direction and the presence of the ship in no way altered its path. Captain M'Quhae, Lieutenant Edgar Drummond, and Master of the Ship, William Barrett watched the graceful giant in their glasses. "Its color was a dark brown with a yellowish white about the throat. It had not fins, but something like the mane of a horse, or rather a bunch of seaweed about its back . . . I have drawings of the serpent made from a sketch immediately after it was seen, which I hope to have ready for transmission to my lord's commissioners of the admiralty by tomorrow's post." Peter M'Quhae, Captain, to Admiral Sir. W. H. Gage G.C.H.

Nathan Hale, who is best known for his last statement in life, had a nephew who edited the *Boston Weekly Messenger* for a time. He wrote in the issue of September 10, 1818 his lamentations concerning the inability of Captain Richard Rich and party to capture "this remarkable animal." After three weeks of pursuit they succeeded in capturing a "Thunny fish" or Atlantic Mackerel of ten feet. Being infrequent in those waters, it was some compensation for the expedition. Nathan Hale (the nephew) wished an audience with "his serpentine majesty" instead of a Thunny fish *(Scomber scombrus).* It was the beast of Gloucester, Cape Ann, and Long Island Sound that he had in mind.

Cuvier, the celebrated French naturalist of the nineteenth century, never had the opportunity to view a sea serpent, but nonetheless pronounced the creature to be ". . . a serpent sui generis specifically distinct from all hitherto described." Cuvier had the support of his fellow scientists, Sir Joseph Banks, the Fellows of the Royal Linnean Society, and the Fellows of the Royal Institution, and they did not have a Thunny fish in mind. A general by the name of Humphries went beyond these scientists, writing to an unnamed correspondent in Boston (June 24, 1818), "I conclude that the last year's serpent is inclined to lay its eggs again this year, and I hope that the brave Americans (i.e., Rich) who were unable to find the monster in their cruise for the purpose of harpooning him, will be more successful in the present summer." Such speculation on egg-laying, while mere conjecture, is amusing. Poor Captain Rich was so plagued by the public for returning with that damned Thunny fish that he drafted a public letter which included the statement, "It was not possible for me to make a Serpent . . . I now take leave of the public, hoping that they will do me the justice to say that I used no deception." As seen by the foregoing letter of Hale, Captain Rich was to be pestered for some considerable time over his attempt, no matter how noble or honest.

The year 1818 had been an extraordinary one for sea serpent sighting, the earliest being July second in which a report issued from Hallowell that a sea serpent was involved in beating whales! This one was said to have arisen fifty feet above the water and throwing his tail from twenty-five to thirty feet struck a whale with tremendous blows, the



Sea serpent from Olaus Magnus
Historiae de gentibus septentrionalibus (1557 edition)

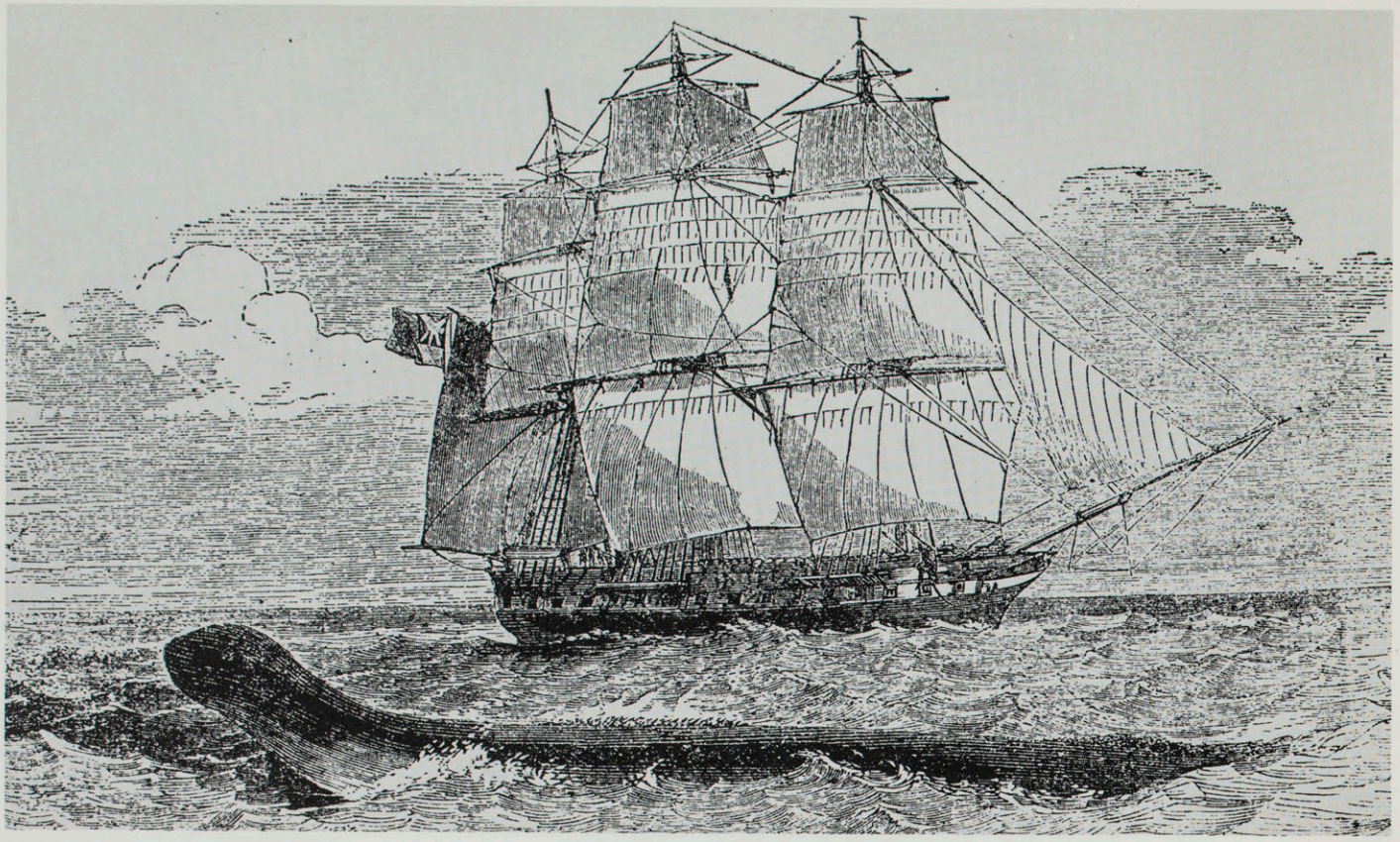
noise being heard for two or three minutes. A bruised and battered humpback whale retreated. The Hallowell report concluded: "We see that the Sea Serpent has gone to California. Very natural." I fail to see what is so natural about such a journey.

Salem reported the next sighting on July 11 of that year. The Monster, christened "Old Neptune," " . . . appeared with a school of 8 or 10 whales and mercilessly thrashed them with his tale while elevating his head 127 feet or more above water." Are we being mercilessly thrashed with a tale, or are these monsters professional whale-beaters? Could it be that the papers of Salem were trying to keep up with those of Hallowell?

Salem continued to print stories of Old Neptune surfacing on July 25 terrifying a man and two boys. At that sighting he was described as having a length of 100 feet and eyes like an ox. On July 31 Mr. William Sargent while fishing, had Old Neptune as a guest for such a period of time that he was able to count 32 protuberances on the serpent's back. On August 4 the serpent was watched for almost an hour by a group of persons on Half Way Rock. They were so impressed that, "a vessel with two boats equipped for war is to sail this morning to encounter The Terror of the Deep. She is manned with bold adventurers." Unfortunately (or fortunately, depending on whose side you take), the bold ones had nothing to report from their foray into the deep waters.

Gloucester was the next village to report a sighting of our protagonist. On August 6, Captain Webber and a crew pursued a serpent twice hitting him with harpoons which glanced off his scales. "His Majesty's dive near the boat caused such a draught as to almost sink the ship. Apparently His Majesty decided to hang around Gloucester in spite of hostile residents. On August 13 he broke water and rose to 50 or 60 feet and was harpooned as before, and with an equal lack of success. It was as though the harpoon had hit upon rock. "A grapnel is now being constructed in this town particularly calculated for this purpose." It did not seem to impress His Majesty, for two days later he surfaced again. Mr. Timothy Hodgkins returning from Newburyport thought that he was witnessing a shoal of bait and found it to be nothing less than "the bunches on the back of the celebrated SEA SERPENT." He raised his head three to five feet, and six feet behind the head were twenty bunches five feet apart. The whole serpent was estimated to be not less than 120 feet. He had a seallike head the size of a rum barrel and was a dark glossy brown. His body was the size of a sixty or eighty gallon cask; there was nothing like fins or gills. By the way, Joe Chase and "two lads" witnessed the whole event. On the following day a monster was seen near the Squam lighthouse, but looked like a gigantic land serpent and had no bunches. Was His Majesty only one monster among several plaguing the area? By August 28th the editor of the *Gloucester Gazette* expressed no doubts about the existence of any sea monster, "It is folly to doubt in the face of abundant and unquestionable evidence." As the fall of the year approached the sightings diminished and apparently "the thing" was gone.

Quite a period elapsed for which reports are scanty, but in 1905 on 7 December two men on the yacht *Valhalla* spotted the Prince of the Seas off the coast of Brazil when the turtlelike head and neck, the thickness of a man, protruded six feet above water. In 1892 Oudemans wrote a book on The Great Sea Serpent and suggested that all of these sightings

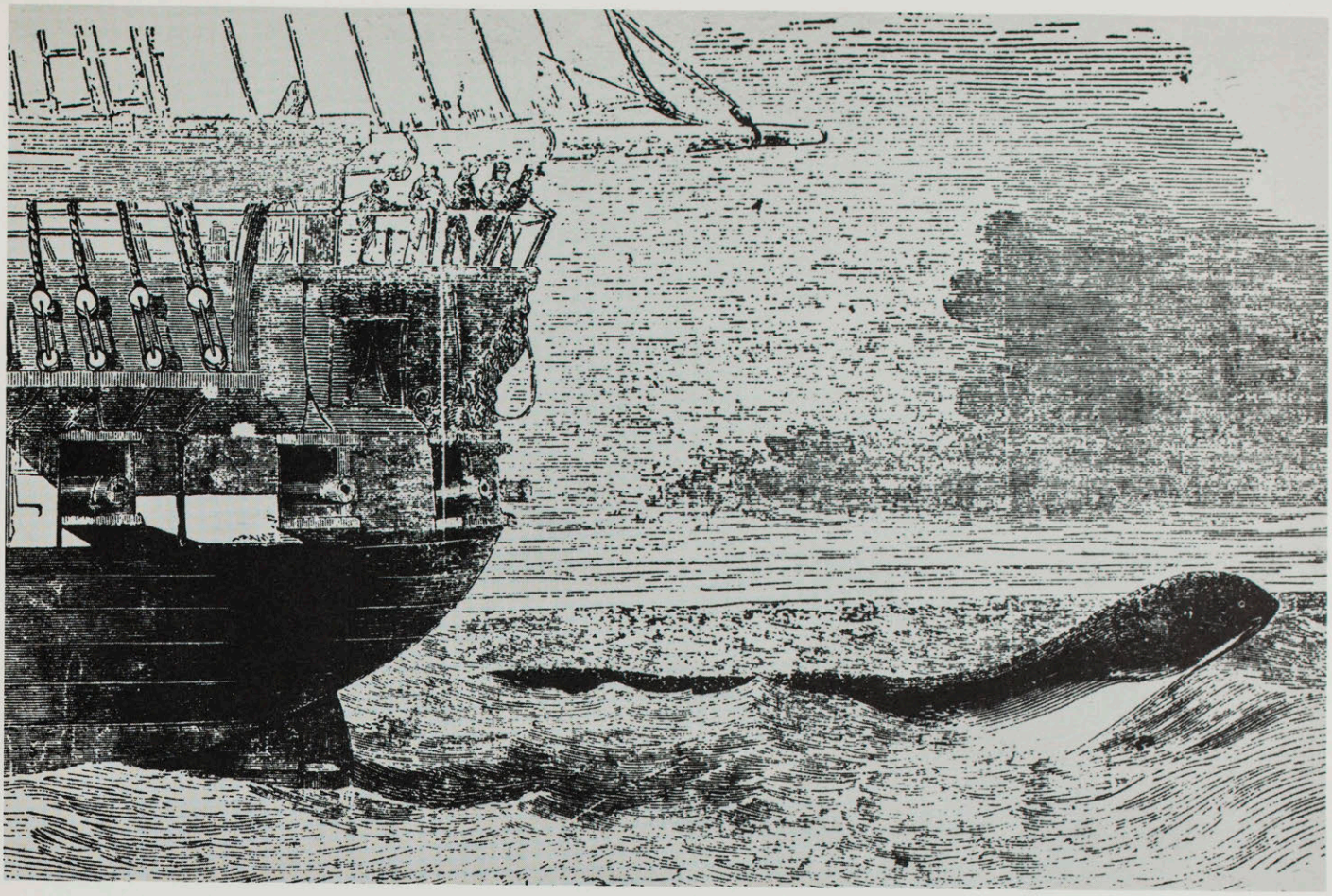


"His Snakeship" seen from H.M.S. Daedalus

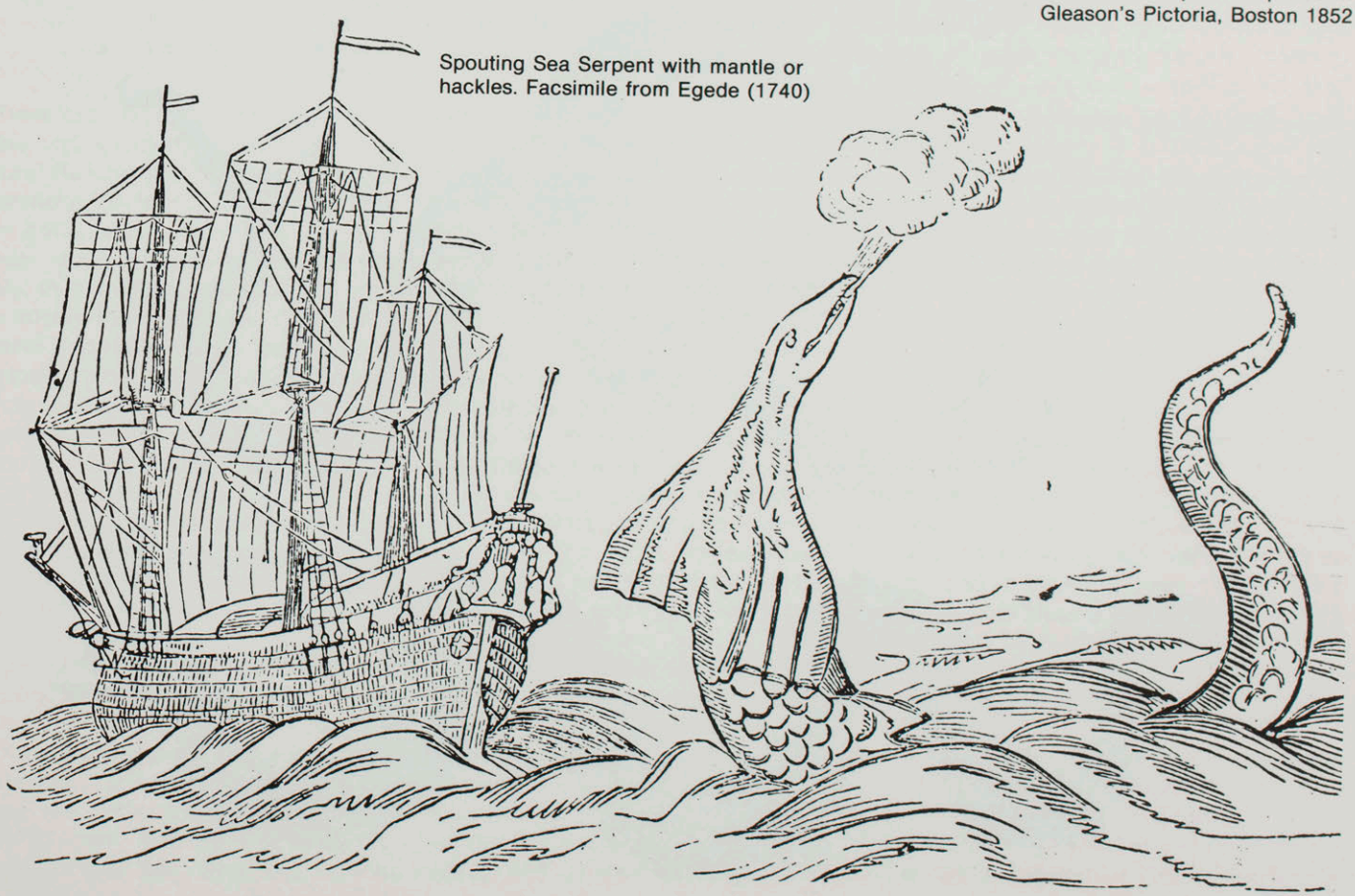
were of an "undiscovered long-tailed mammal allied to the seals and walruses." Other hypotheses are that the serpents are Basking Sharks *(Cetorhinus maximum)* that swim in pairs, their bodies just behind one another and their dorsal fin protruding. Porbeagles *(Lamna nasus)* have also been contenders along with my favorite (because of the Latin binomial) *Chimaera monstrosa.* Nemertines reaching a length of 45 feet are not a bad bet either. How about sea lions surfacing in fading light of day? The most realistic explanation of these whale-beating monsters may be the gigantic squids of the genus *Architeuthis* which attain a length of 50 feet and have a broad distribution from Scandinavia, and the British Isles to the eastern coast of North America. Swimming on the surface, such a gigantic squid would be the perfect sea serpent; a cylindrical shape with a flattened head, appendages on the head and neck like a mantle or mane, spouting water. Whales, especially the sperm whale, devour these, and in the process the tentacles may wrap around the whale's body. The sounding of the whale while eating is not unusual, and this may account for the beatings. All of these still do not explain the photographs and radar soundings from Loch Ness, but that is a story unto itself.

Clearly, there are several classes of sea serpents as well as several classes of reporters of same, and we may periodically expect reports to appear in newspapers. Wouldn't it be nice to have a summer of 1818 again with all of those Aqueous Princes like Old Neptune cavorting about? At present, we may content ourselves with at least one of the sea's most bizarre outputs, our own embalmed and resin-cast oarfish destined to be a wondrous sea serpent in the nearly completed Marine Hall.

William Emboden is the author of Bizarre Plants *to be issued by The Macmillan Co. in May of this year. He is a permanent fixture in Terra.*

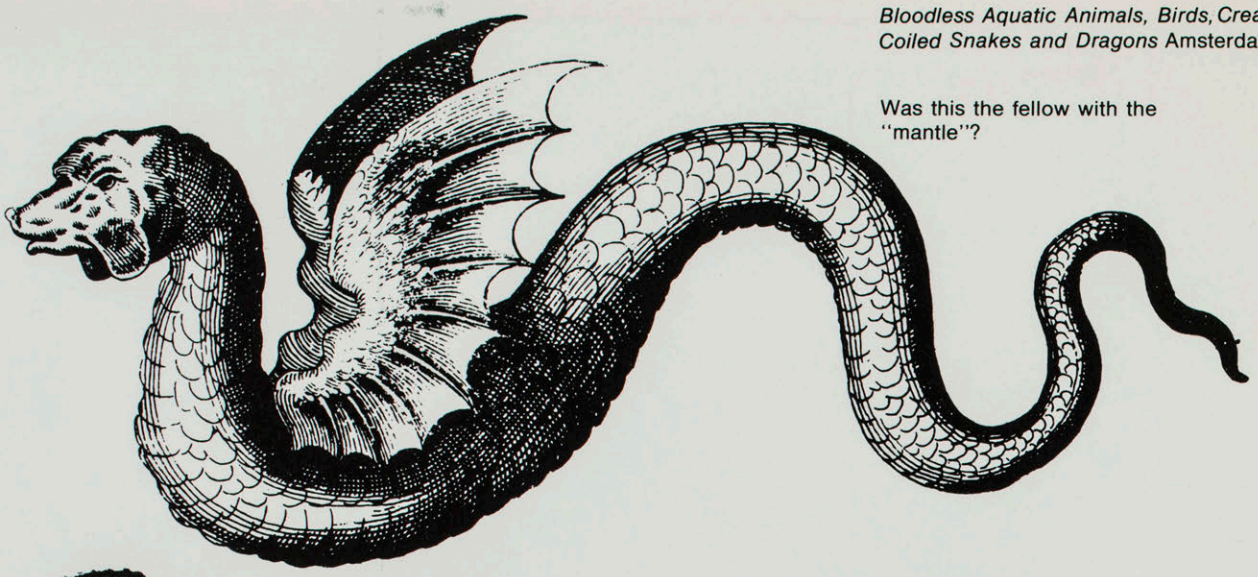


"The Great Sea Serpent" depicted in Gleason's Pictoria, Boston 1852

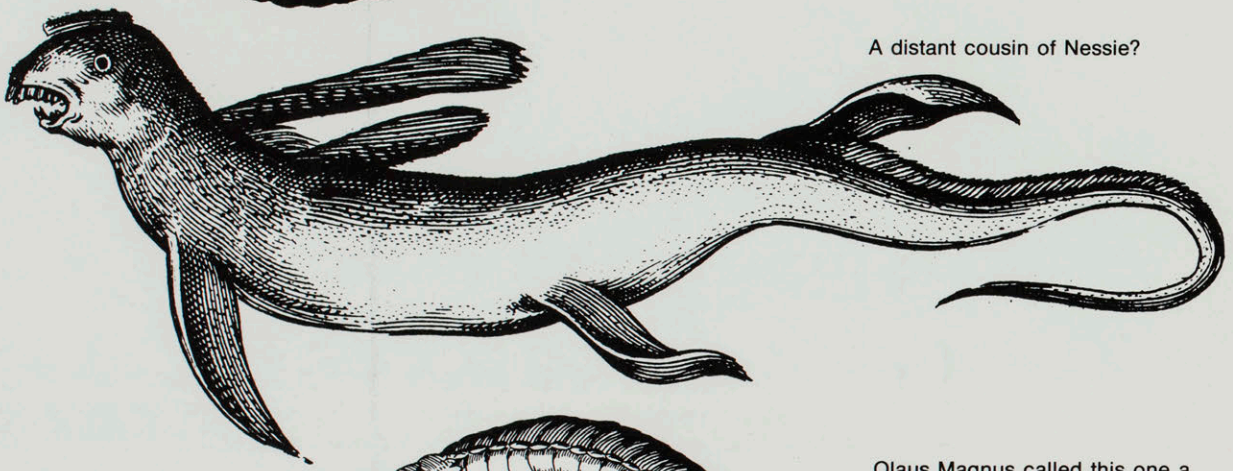


Spouting Sea Serpent with mantle or hackles. Facsimile from Egede (1740)

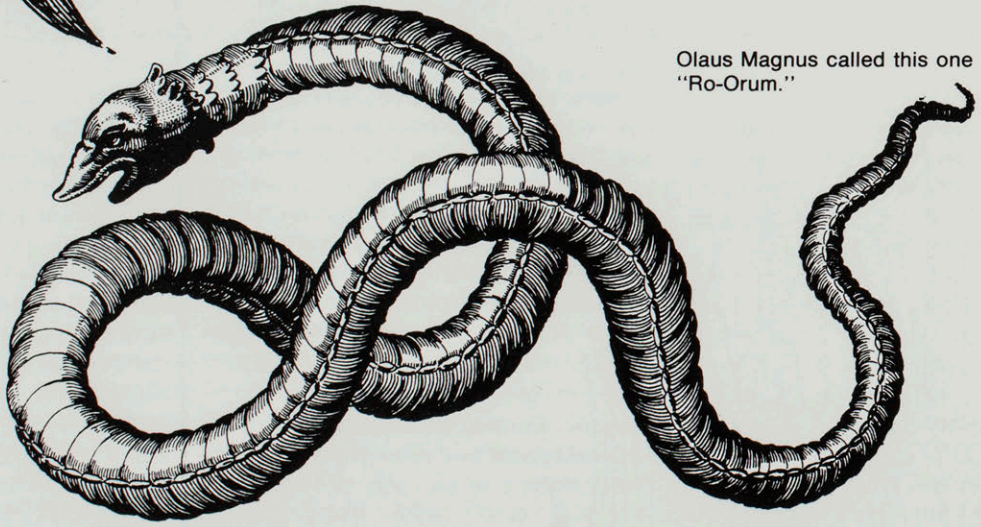
Bloodless Aquatic Animals, Birds, Creatures, Coiled Snakes and Dragons Amsterdam 1660



Was this the fellow with the "mantle"?



A distant cousin of Nessie?



Olaus Magnus called this one a "Ro-Orum."

The thing looked very much like a serpent.

SHE'S A NATURE FAKER

OR THE CONFESSIONS OF A LADY PREPARATOR

by **Peggy Kayser**

There are eleven exhibit preparators in the Los Angeles County Museum of Natural History. Nine of them are in the Exhibitions Division. But two of them have gone Underground!

Deep down in the bowels of the Museum, in the Education Division, there is a place that teachers, concerned parents and youth group leaders know and love. It's called the Lending Service, which for twenty-six years has been supplementing the experiences of thousands of young people. For an annual fee of three dollars, one can check-out such varied exhibits as a sabre-tooth cat skull, a model of Columbus' ship, or an ocelot. And it is there where those two preparators give birth to the exhibits for loan.

My work, as one of these exhibit preparators, is in the field of biology. There is also the dubious distinction of being the only woman preparator of exhibits for display in the Museum. That in itself makes the Museum a very interesting place to work, but there is more enchantment than that. Originally, with an interest in both art and biology a college curriculum in environmental design was finally chosen, but the hope remained alive that somehow biology could still be a part of my profession. Natural science exhibit making at the Natural History Museum has given me that opportunity.

The position carries with it a great deal of responsibility since the preparator is actively involved in the education of children. Each exhibit is a learning situation. An animal exhibit must say more than "Here is an animal!" It should indicate the region, climate and soil where the animal lives as well as the things that it eats—or that eat it, as the case may be. It should tell as much as can be told about the habits of that animal within the limits of a few cubic feet.

In order to do this kind of exhibit we receive a taxidermy specimen which must be carefully identified so that it can be put in the proper ecological setting. Once the research is done, the exhibit materials must be assembled. This involves the acquisition and drying of plants and ground cover, particles of soil, and food items—usually vegetation, fish or insects.

In many instances the presence of water in some form is necessary to convey a concept; and then a method must be devised to simulate the kind of water desired, whether it be surf, running stream or still standing. The materials used for water are varied: for splashing surf small caps or waves are built up with spackle and painted to resemble seawater. For a running stream a rippling surface can be sculpted out of clay, a plaster cast made of that, and then a machine called a "Vac-u-mold" is utilized. It makes a clear plastic mold by heating a sheet of heavy plastic and pressing it around the plaster cast forming the desired shape, in this case, stream water. For standing water white glue can be used to fill in the water area. When it dries completely it turns relatively clear and gives a very good approximation of still standing water.

The improvisation involved in these exhibits is more than one realizes. When possible, the actual item called for is

used; but sometimes it must be slightly improved upon. There were some exhibits that included parts of an oak tree and for this purpose a bag of acorns was obtained. Unfortunately they had dried out and the caps had fallen off most of them. The acorns were all different sizes and we all know that the caps really only go back correctly on the acorns from which they came. So the afternoon was spent sorting out the acorns and gluing the caps back on. While engaged in this activity it occured to me how easily we preparators presume to improve upon nature. There is a certain amount of arrogance inherent in this job.

Sometimes really bizarre materials are utilized to make very common items. For instance, there was a series of five separate bullfrog exhibits, depicted as living in a very cool, moist environment. To help create that feeling, groups of toadstools (no pun intended) were to be incorporated into each exhibit. To do this fifteen toadstools of varying sizes were necessary. The rough shapes were carved out of styrofoam and then dipped into an extremely viscous solution of "plaster of Paris." The plaster hardened and they were then painted and incorporated into the exhibits.

When doing exhibits of this nature it is helpful to have a variety of natural materials on hand; thus every nook and cranny of our workshop is bulging with reeds, grasses, branches, bark, lichens, rocks, pebbles and buckets of dirt, sand and gravel. Of course, one never has enough different kinds of things and the next exhibit is always different from the last. Therefore there is a whole corps of people, friends and co-workers, who scout the countryside for the necessary materials. The day after a long weekend the Education Division looks a bit rustic, full of plants that have been brought in but have not yet found a home in the workshop.

Last year the Lending Service fell heir to the preliminary scale models from the African elephant habitat group as well as the accompanying miniature painted backgrounds. The perfect beginnings for a nice diorama for lending. All that was

lacking was the foreground. Various types of miniature foliage to simulate shrubs, thornbush, and succulents were necessary. Some things were fashioned completely from wax and paper. For others different plants that gave the correct impression, in scale, were substituted. But there were some little scrubby plants that created a problem. I decided to use "deer lichen," which is a bright green plant that grows commonly on the large pines in our local forests. Unfortunately neither our Division nor the Exhibitions Division had any. The word went out to the "corps" to gather some lichen if they happened through a likely lichen area; but none of us was free to search. What a predicament, five projects waiting . . . "My kingdom for a lichen!" Weeks went by, other projects were started and completed, and there sat those five big projects . . . waiting. Finally one of the staff located a large old box full of dried lichens of all kinds in some corner of the Museum. The projects were completed. But then the real fun began. Every person aware of the problem then began to bring lichens, sometimes with the pine trees still attached! The lichens were piled as high as an elephant's eye. The job is not without hazards.

Many times it is necessary to take to the fields in search of materials. In addition to inanimate materials often small mammals, snakes, lizards, fish and insects are collected as well. The insects are mounted either in the traditional museum manner, pinned in black boxes called Riker mounts, or in a lifelike manner for use in an exhibit. The small vertebrates that are collected are mounted in a rather novel way. They are usually not taxidermied in the traditional sense. This is because the two Museum taxidermists have an extremely busy schedule, meeting the need for display in the large habitat groups upstairs. So to add small mounted vertebrates to our collection the Lending Service must devise other means. Some years ago the Museum purchased a freeze-drying machine. Using this device the preparator can take a small animal such as a squirrel, a fish, a hermit crab or a lizard and put it in a life-like position using any external supports necessary. It is then super-frozen and put in a vacuum chamber where the frozen water is drawn off. The animal is then weighed periodically, and when it stops losing weight, which is actually the water, the process is finished. All the supports are removed and you have a life-like mount ready to be displayed. In this way our

Photos by Armando Solis

Once part of the original model of the African elephant habitat group on the main floor of the museum, this bull elephant forms the focal point for a lending service exhibit prepared by Peggy Kayser

Improving on nature. When dried these acorns will not lose their caps

many needs can be met without diverting the energies of the taxidermists from the habitat groups in the main Museum. Freeze-drying does have its limitations, however. And the prime limitation is one of size; our vacuum chamber is only a drum 9" × 17". So an alternative to freeze-drying must be found. For larger animals it was necessary for me to learn taxidermy. This was really the only practical solution.

The first technique learned was a sort of mass production "taxi-sculpture." The animal is skinned and the hide tanned. Then using the carcas as a reference an armature is made utilizing the cleaned skull, and the body is sculpted out of an oil base clay. Care is given to minute detail. A simple two-piece plaster mold is then made of this sculpted form. From this we can make many bodies—as many bodies as we have skins that are relatively the same size. Just as with clothing, sometimes alterations are necessary. The skins need to be let out or taken in to fit. To make the animal form, a maché of sawdust and liquid neoprene rubber is mixed, and then pressed into the mold. The two halves are then glued together and the skin is stretched over, glued and sewn in place.

The first attempt at this technique was going to involve ten jackrabbits as there were none mounted in the Lending Service and they have a reputation for a certain abundance. Once again the aid of biologists, friends and staff members was enlisted, but still no rabbits. Apparently the legendary rabbit fertility is but a myth. Perhaps the elusive rabbits are like lichens and someday soon there will be a great rabbit deluge on the Education Division.

It is really very rare to actually have to collect animals. We seem to fall heir to so many. Wild animals get run over and people bring them to us. Animal control calls us when they have an exotic animal that must be destroyed. We acquired the wolf that the police shot because it was terrorizing the citizens of Gardena last Christmas. Next a Japanese Macaque that had been a pet but reverted to a wild state was given to us and the hide is now in the process of being tanned. In this case the body, once it was skinned, was wired and positioned and a plastic mold was made from the actual animal. Then a neoprene body was cast from that mold. It's very satisfying to be able to work on a project from the very beginning to end—from the skinning to the taxidermy, from the background to the foreground, from the research to assembling the plexiglass case that protects the finished exhibit from the elements, including exuberant animal "petters."

There is a third way that we acquire mounted animals and it is called serendipity; finding in an infrequently opened storeroom, back in a dusty cranny, some old specimen taxidermied long ago and forgotten about. We once acquired through this kind of discovery a life mount of a mongoose seemingly perusing an imaginary snake. The pelt was so old that the animal was balding on one side. But with a clever method of display the bald spot will not show and we will have a most exotic display. Now, does anyone have a cobra that he would like to see immortalized?

Adding to the multiplicity of duties is the repair of items damaged from use in the Lending Service. On my desk one might find a sabre-tooth cat whose sabre tooth has fallen out, an opposum lacking a tail, a baby armadillo splitting his seam or a cracked quail egg in a nest. Some days it might be nice to have the services of "all the King's horses and all the King's men."

This year for the first time the Education preparators have had some outside help. The Museum has a wonderful volunteer organization called the Docent Roundtable. It consists of one-hundred and forty-five women who devote part of their time helping the Museum by doing volunteer work. The Docents give tours to the school classes that come to the Museum, do promotional speaking for the Museum, and work with the curators. But it was only this year that we discovered Docents brave and hearty enough to work for the Lending Service; and the results have been overwhelming. They have been very helpful in doing research for the text material appended to the historical objects and reproductions purchased for use in the Lending Service. One docent tackled the preparation of a kit dealing with the varied uses of plants by our California Indians. This was a highly pertinent project because there is a great emphasis on California Indians in the Los Angeles City School curriculum. The Botany Department cooperated with our docent, aiding in her research. She wrote the text for the kits and then stomped through the chaparral, desert and pine forest gathering plant specimens. She rendered the plants for use the way the Indians would have done, such as painstakingly splitting the fibers of a Yucca leaf with an "X-acto" knife to make an Indian paintbrush. Actually the "X-acto" knife was a slight improvement over the old Indian way. She and her husband became so enthusiastic that they roasted pinecones in their fireplace to get the pinyon pine nuts out—but unfortunately burned the cones to a cinder, nuts and all. (Their second try was more successful.) In an act of bravery, they sampled almost all the edible plants in the kit! For inclusion in the kit she did a set of beautiful pen and ink drawings of each entire plant so that the children would be able to recognize them in nature. The enthusiasm that she displays is reflected in her work and in turn inspires the children. We are very lucky to have this kind of assistance.

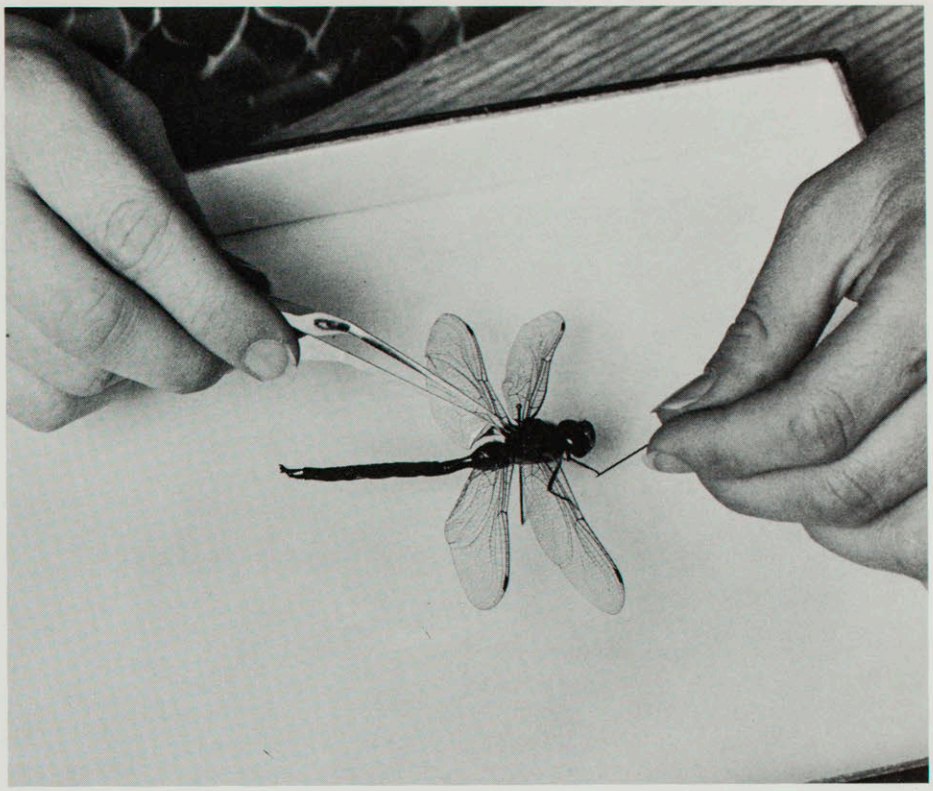
Preparing a Japanese macaque skin for taxidermy

Not only do we have enthusiastic Docents; but the teachers who use the service are inspired, too. For the most part they are very understanding in regard to our limitations, and some of them are very helpful. They bring us rocks and shells and dead animals and all sorts of things that they think we could use in our collection. We appreciate that kind of interest and they, too, seem to appre-

ciate us. One teacher who checked out a raccoon habitat came back with a set of poems that his class had written, "Haiku for a Dead Raccoon." Last Christmas another regular customer brought us a two pound box of candy. Her students had taken up a collection to buy some candy for the "people that made all those things for them."

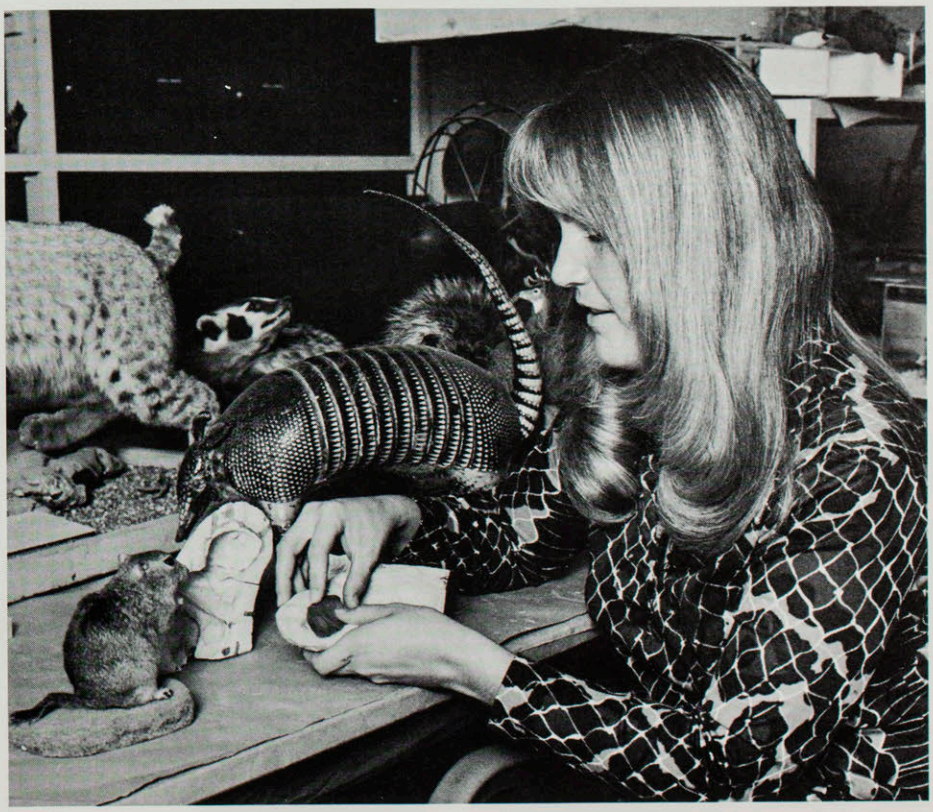
Being an exhibits preparator is interesting work and in my case it carries with it many extra rewards. Through working with the teachers, feedback concerning the exhibits is gleaned from them on the usefulness of the exhibits and on improvements that could be made. They often suggest ideas for new exhibits that would aid them in their teaching and this is kept in mind when new exhibits are designed. Most of the teachers who utilize the service teach in the inner-city schools where many of the students have never had the opportunity to see the wild animals that we take for granted, like raccoons, squirrels, jays, and quail. It gives me great pleasure and satisfaction to know that I may have in some way broadened their experience and given them a better sense of the wonders of nature around us. For what greater satisfaction could a "nature-faker" ask?

Peggy Kayser was born and raised in Santa Monica where she graduated from Santa Monica College as an honor student. Before coming to the Museum in 1969 she graduated with a B.A. in Environmental Design from U.C.L.A. She has worked as a teaching assistant in both biology and art and enjoys both fields equally. Her work as an exhibits preparator in the Education Division allows her to combine her interests. Newly married to a graduate student in biology, she and her husband now reside in Silverlake. This is her first article for TERRA.



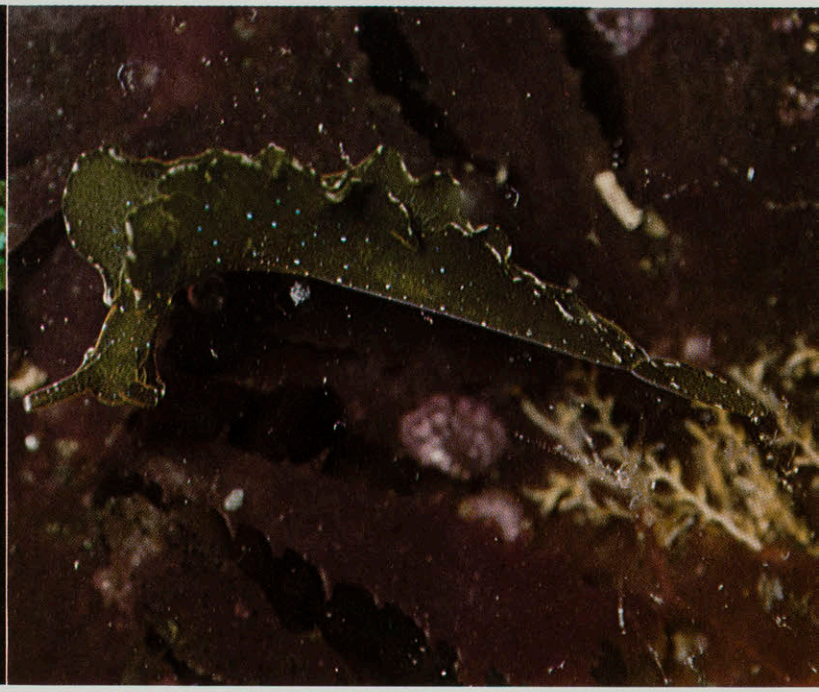
A special surface and fine tools are utilized in the delicate process of mounting a dragonfly for display

Removing the original sculpted clay "body" from the plaster mold which can now be used to "mass produce" taxidermy forms



This Green Dragon *(Oxynoe antillarium)* can throw its tail in the same manner as a lizard. Photo by K.B. Meyer.

Fairly common along the California coast, *Elysia hedgpethi,* is difficult to see when on its natural habitat, the green algae *Codium.* Photo by Richard Roller.

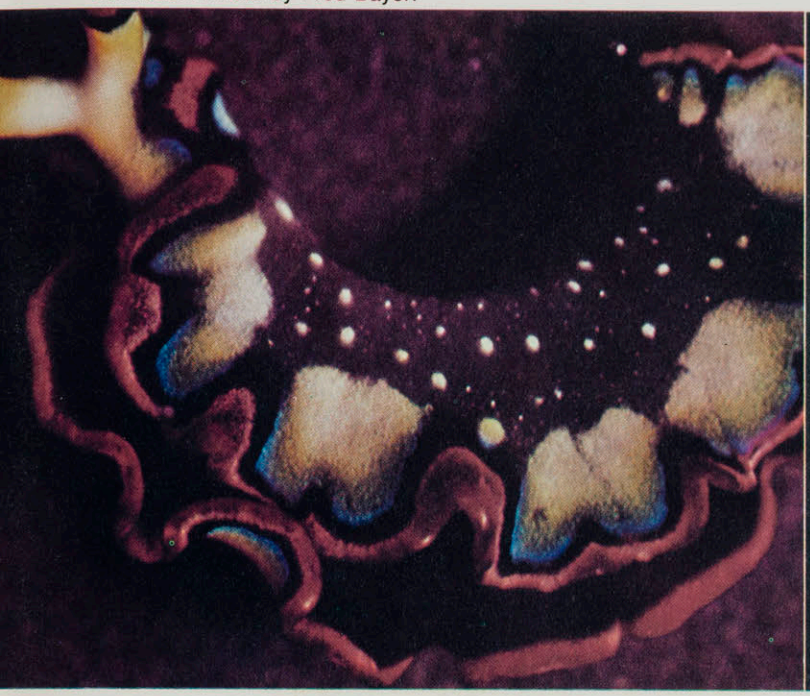


GREEN

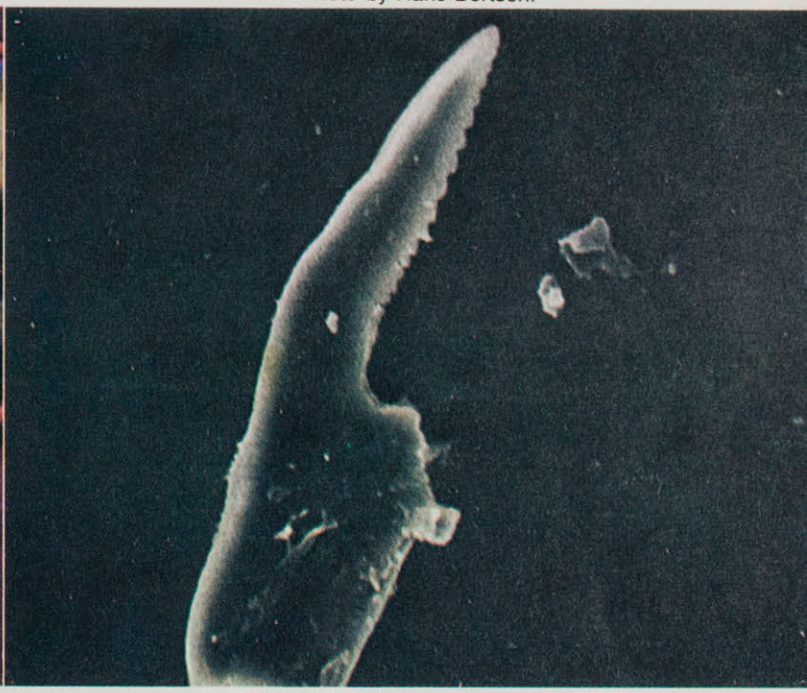
Another view of *Lobiger* showing how the animal can wind up its parapodia. Photo courtesy of Stanford University Press. Reprinted from Sea Shells of Tropical West America, by Myra Keen, plate XIX.

A world wide warm water species, *Lobiger souverbii* is seen here on one of the many varieties of the algae *Caulerpa.* This particular specimen shows the fully developed lobes of parapodia. Photo by Sally Kaicher.

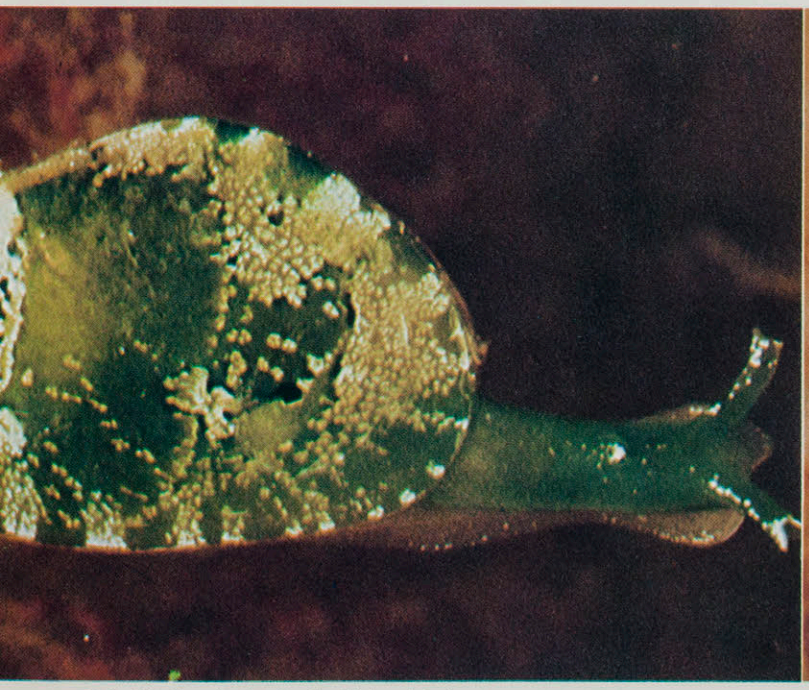
One of the more colorful of the Dragon clan is *Elysia duis* from the Caribbean. Photo by Fred Bayer.



Enlarged 115 times this scanning electron microscope photo shows one of the saw-like teeth which the green dragons use to obtain their food. Photo by Hans Bertsch.



DRAGONS



Only ¾ of an inch, *Berthellinia chloris* has won world wide acclaim as the "Bivalved-Gastropod." Photo by David Mulliner.

Berthellinia chloris. Photo by David Mulliner

GREEN

A green dragon with rabbit ears may sound strange, but a casual trip to the seashore would provide you with many of them. If you get down on your hands and knees and crawl through the algae you may find yourself head-to-head with a green dragon. But don't worry: they are only an inch or two long, and most of them eat plants.

The green dragon is a marine gastropod, or more simply, a kind of sea slug. The rabbit ears on top of the head are actually its antennae, and they curl so evenly that one could easily mistake them for an ocean-going bunny. Still, if all you can think of when you hear "slug" is "ugh!", then pause a while and meet some new friends.

A malacologist (scientist who studies mollusks) will tell you that green dragons are actually sacoglossan opisthobranchs. To know what that is all about, a short lesson in taxonomy is necessary.

Opisthobranchs are distinguishable from the other kinds of gastropods by numerous evident and not-so-evident characteristics. For instance, the pulmonates are land snails and slugs, living in a completely different environment than do the green dragons. Prosobranchs (the second group of gastropods) is the scientific name for what you and I call sea shells. This name means "gills up front." Most of these animals have a shell that covers their entire body, and the intestines are situated way up inside the shell. To get waste material out of their body, their body's construction has twisted itself around, so that when the animal is crawling both the anus and mouth are situated outside the shell. In this evolutionary process, the gills have also moved to the forward regions of the animal.

Green dragons belong to a third group of gastropods, called opisthobranchs. They have reduced or completely lost the shell in the adult stage, and have untwisted themselves. As a result, their gills are located "towards the rear."

Sacoglossans, then, are one of eight major kinds of opisthobranchs. Most of them are green, but there are exceptional brightly colored animals, flashing forth spectacular combinations of reds, yellows, and blues. *Tridachiella diomedea,* popularly termed the Mexican Dancer, occurs in the Gulf of California. Its basic green color is enhanced by orange and black specks salt-and-peppered along the ruffled edges of its flaps. Along the outside are occasional blue streaks.

Most of the sacoglossans eat algae. The only known exception is a species that occurs along the northern Pacific Coast of America, and eats the eggs of other opisthobranchs. The algae-eating sacoglossans are all characterized by a unique anatomical structure. Their radula (teeth structure) consists of a single row of teeth, ending in a sac where the worn teeth are discarded. When these animals feed, they make a slit in a piece of alga, and then suck out the inner contents. This piercing action can be better understood by examining the scanning electron micrograph of a single radular tooth. There are backward-pointing serrations along one edge of the lance-like tooth. The animal apparently pierces the cell wall of the alga, then when it withdraws its tooth, rips the hole open wider. Then it can readily suck out the cell's contents.

Their eating habits have also evolved a remarkable endosymbiotic relationship. Chloroplasts from the algae actually live inside the body tissues of the green dragons, as functioning, photosynthesizing units. The animal gains the chloroplasts initially by eating its alga food. Morever, the sacoglossans can and apparently do utilize various photosynthetic products from these chloroplasts. By using radioactive-labelled compounds, scientists have found out that the products of the chloroplasts pass especially to the foot glands of the animal.

Sacoglossans are slimy animals, even to one who loves them, and they use the photosynthetic products to help make mucus.

Since the sacoglossans are dependent on plants, and plants are dependent on sustaining light, and sustaining light will only penetrate sea water to a depth of 660 feet, it follows that the group lives intertidally or in relatively shallow depths. Even though the group is fairly common in the intertidal area, they are often very difficult to find in the field. The resemblance between the animal and its host plant is generally quite remarkable. The animal can look like a "bump" or branch of alga. The easiest way to collect these

by **Gale Sphon**
and
Hans Bertsch

DRAGONS

animals is to bring home a small clump of the alga in a bucket of sea water, and then periodically examine it for any movement among the still branches.

One of the most exciting discoveries made about mollusks in this century concerned a sacoglossan. For a long time, malacologists had been examining both fossil and dead recent specimens of what they considered to be a clam shell. Then in 1959, Siro Kawaguti and Kikutaro Baba reported finding the animal alive off Japan. It was not a clam, but a sacoglossan, and made an instant hit around the world as "The Bivalved Gastropod." It has since been found on the green alga *Caulerpa* in Australia, Hawaii, the southern Gulf of California, the Galapagos, and Jamaica. Relatively unknown just a few years ago, there are now many details known about its specific relationship with *Caulerpa* alga. Even knowing where to look, it is very difficult to detect the living animals in their natural habitat because both the tissues of the one-half inch long animal and its shell have the same shade of green as the alga.

Another species of the green dragon order that is found on *Caulerpa* is *Lobiger.* This animal is a bright green with light blue lines and has four lobes or parapodia extending out from its sides. Ideally, these parapodia are broad and flat with scalloped edges. However, the size and shape of the lobes depends on their stage of regrowth. When disturbed, the animal can autotomize, or spontaneously cast off, one or all of the lobes. If the animal does not actually autotomize the lobes it can screw them up into tight, pointed, little balls held close to the sides of the body.

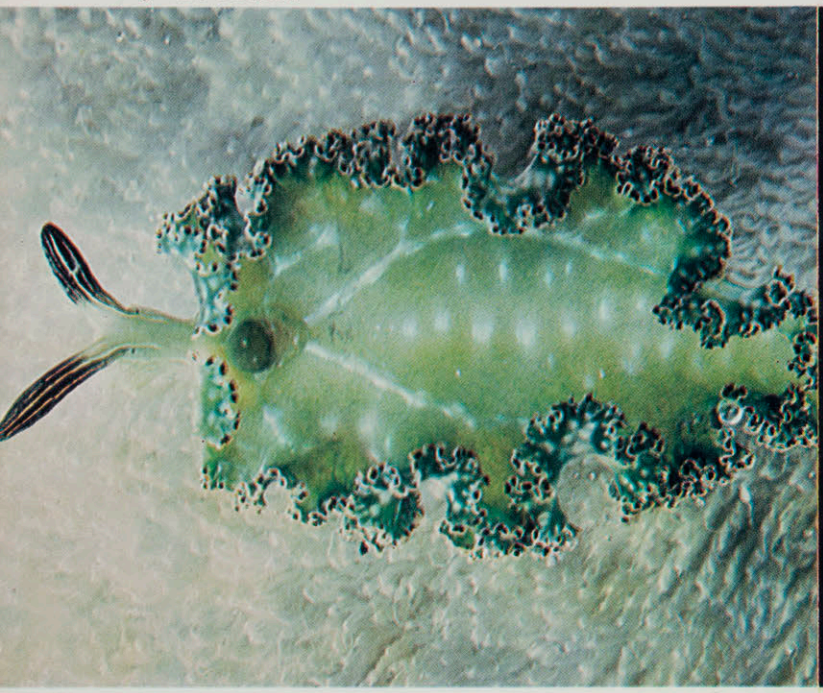
Oxynoe, another sacoglossan living on *Caulerpa,* looks much like *Lobiger* but it doesn't have the prominent lateral lobes. *Oxynoe* can autotomize its tail like a lizard, which *Lobiger* cannot do. When *Oxynoe* is disturbed or irritated, it has another defense mechanism. It secretes a poisonous substance, which at even very light concentrations can kill a small fish within fifteen minutes. It is conjectured that *Oxynoe* obtains this poison from its algal food stuff, although this has not yet been proven.

Although these animals seem to occur under rather restricted habitats, they have evolved many different adaptions to living within their narrow worlds. There is a popular song about a dragon that lived by the sea, only to be discovered by a little boy. As the boy grew up, and learned that dragons do not really live, the dragon went away. But not so our green dragons. They are actually crawling and swimming along the shores of the ocean, needing only the careful observer to spot them. The more we learn about them, the more the green dragons will teach us to find out more—in their natural habitat. Hopefully, we will let them stay there, so our children, too, can grow up knowing about the green dragons of the sea.

Gale Sphon is a curatorial assistant in invertebrate zoology at the Natural History Museum of Los Angeles County. This is his third Terra *article.*

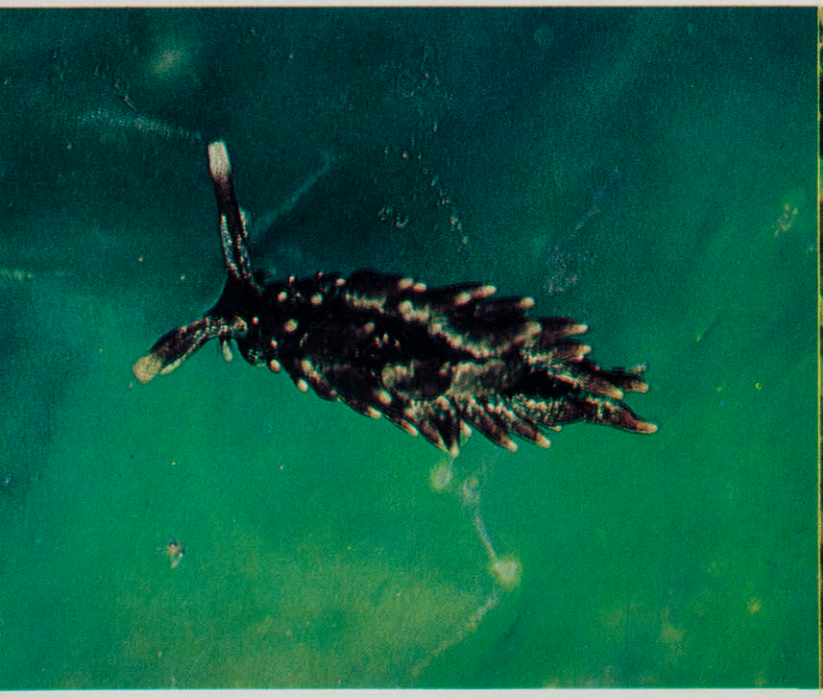
Hans Bertsch, an Associate of the California Academy of Sciences, is studying for his Ph.D. in Zoology at the University of California, Berkeley. He has described several new species of Nudibranchs from the Gulf of California.

The Mexican Dancer or *Tridachiella diomedea* is quite common in the Gulf of California and sometimes reaches four inches in length. Photo by Hans Bertsch.

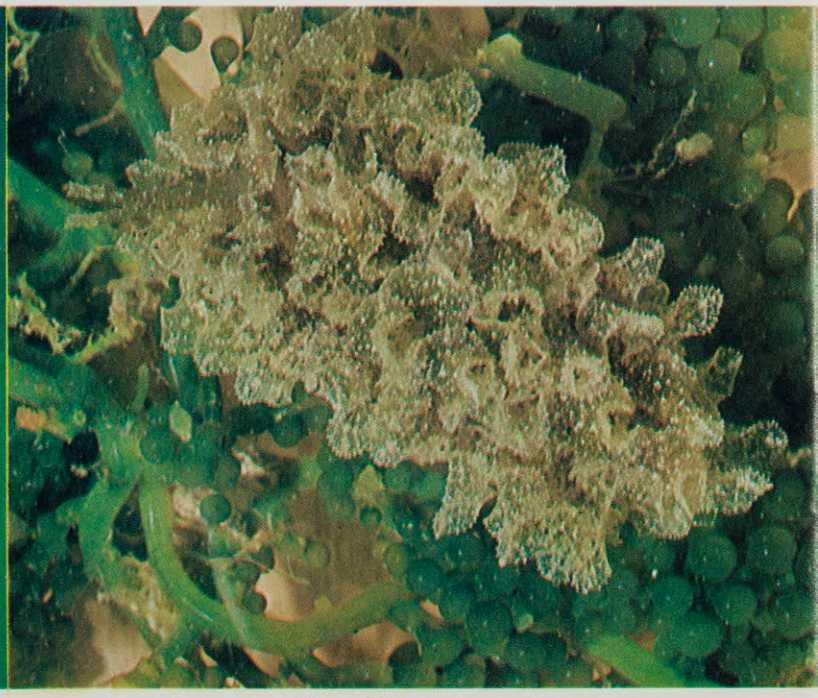


When it reaches maturity *Placobranchus* utilizes algal chloroplasts to manufacture its food. All research on the subject leads us to believe that it no longer feeds when it becomes an adult. Photo by Richard Roller.

GREEN

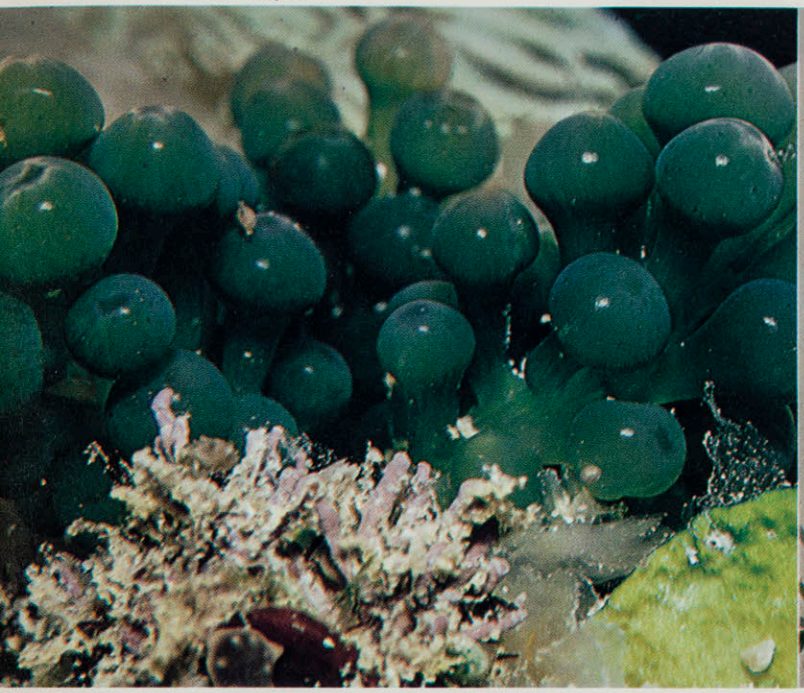


A moderately common species found along the Californian coast is *Hermaeina smithi.* It lives in the very high tide area on a filamentous green algae. Photo by Richard Roller.



A large (3 inches) animal *Phyllobranchillus viridus* occurs both in the Atlantic and Pacific. Photo by David Mulliner.

A type of green algae *Caulerpa*.
photo by Valerie Taylor



A type of green algae *Caulerpa*.
photo by Sylvia Earle

DRAGONS

A type of green algae *Caulerpa*.
photo by Sylvia Earle

A type of green algae *Caulerpa*.
photo by Sylvia Earle

Trilobites

Trilobites are extinct marine animals that swam, crawled, and dug in crab-like fashion in the seas of the Paleozoic Era from 225 to 570 million years ago. Shown here is part of a stony slab with 50 specimens of the trilobite *Homotelus bromidensis,* a stunning gift of the museum's Foundation, that is on permanent display in the Invertebrate Fossil exhibits. The animals are huddled together in a mass death, possibly quietly asphyxiated by red tide conditions during Middle Ordovician time, 470 million years ago, on the sea bottom at a place destined to be called Oklahoma. Photo by Lawrence S. Reynolds.

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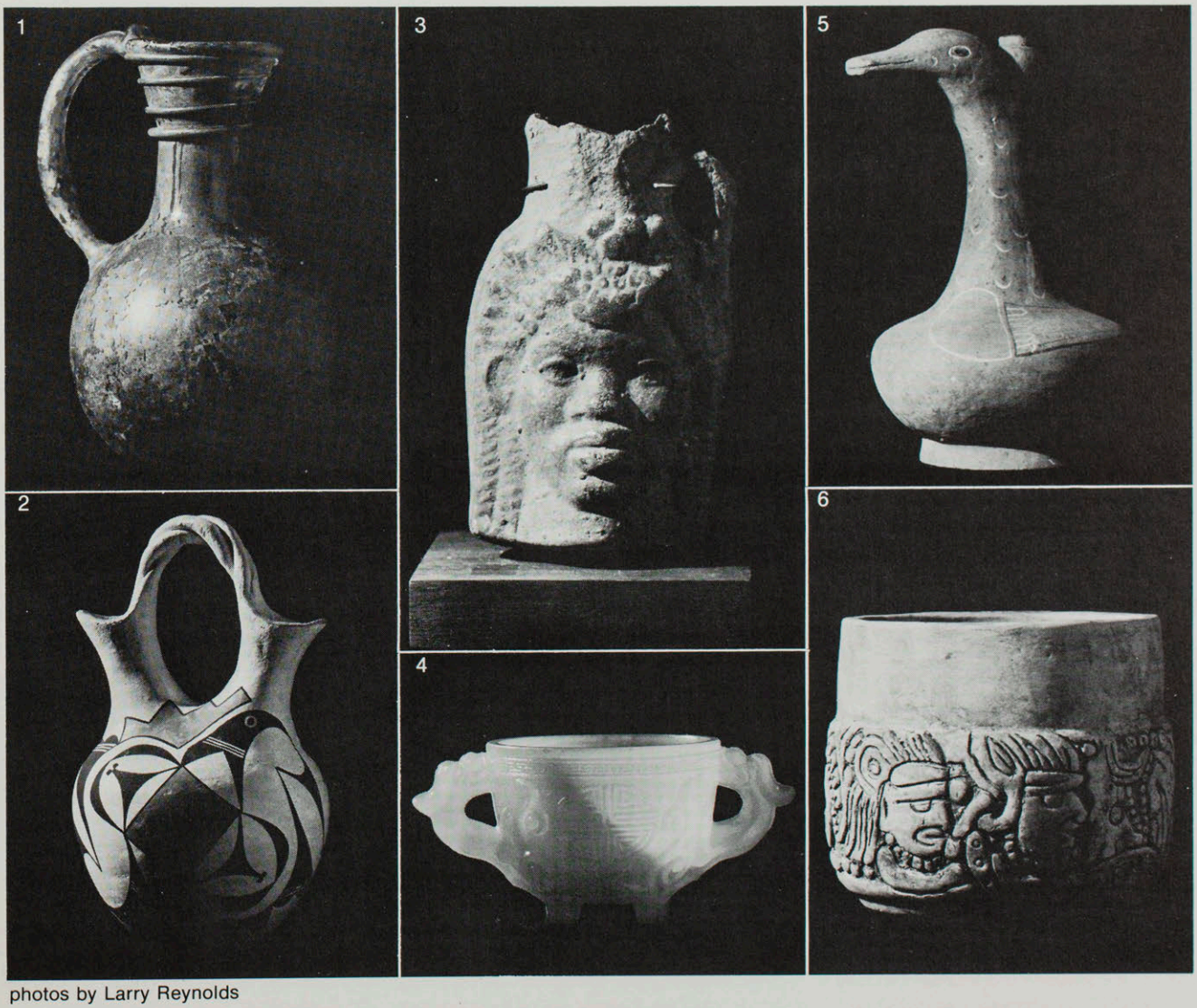

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